

JUN 29 1923

A. R. A. MECHANICAL DIVISION PROCEEDINGS

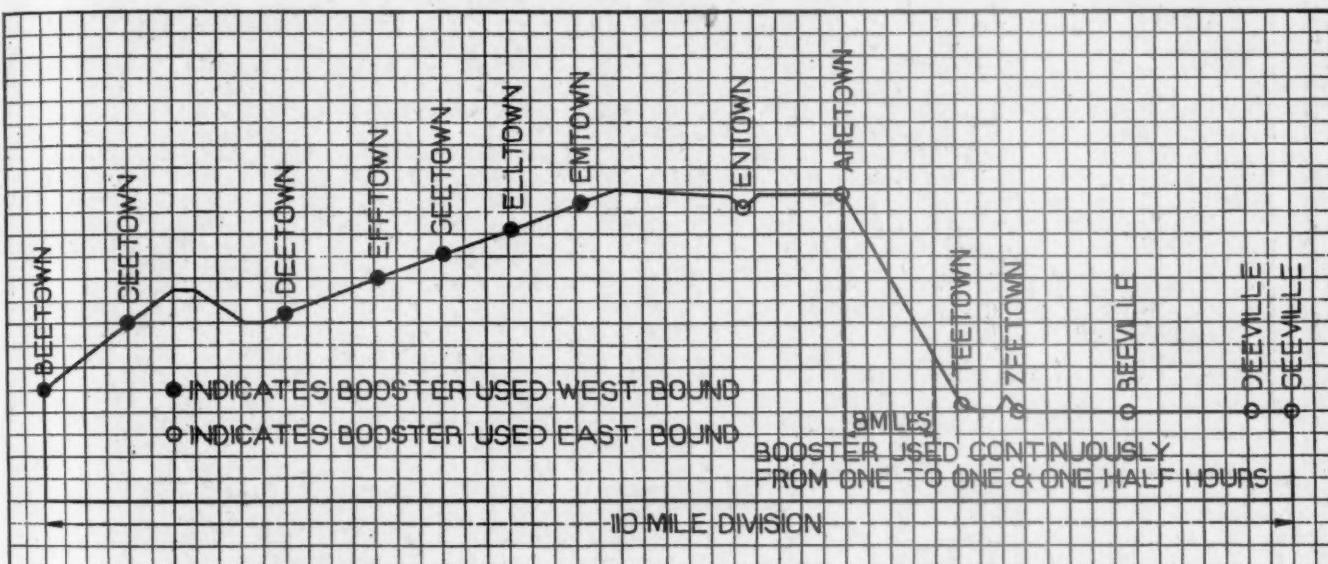
Railway Age

FIRST HALF OF 1923—No. 29

NEW YORK—JUNE 23, 1923—CHICAGO

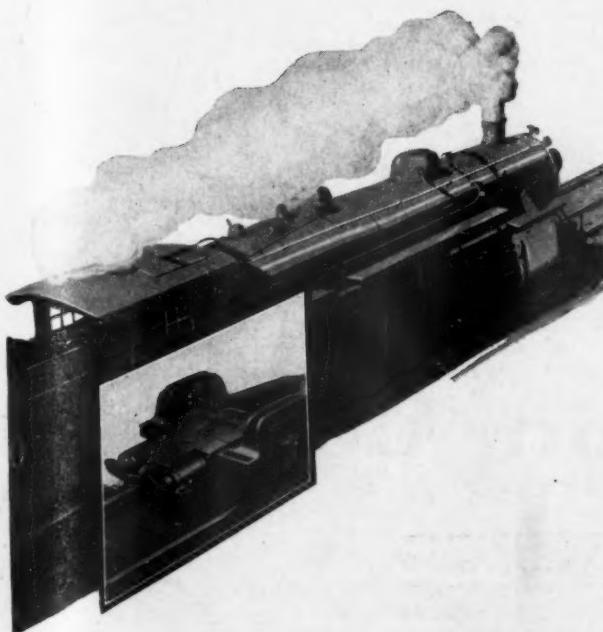
SIXTY-EIGHTH YEAR

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EDITORIAL



The Table of Contents Will Be Found on Page 5 of the Advertising Section

Practically simultaneously with the announcement that the American Railway Association had set up regional advisory boards of shippers came word from

"Local Joint Committees" England of the establishment there of "local joint committees" to provide similar co-operation between the railways and shippers.

The regional boards in this country are composed wholly of shippers and will have direct contact with railway officers and local representatives of the Car Service Division. In England, on the other hand, the contact between the shippers and the railways takes place within the committees, which are made up of an equal number of representatives from the carriers and the shippers—or "traders" as they are called there, a term which embraces both shippers and receivers of freight. The powers of these committees are well defined; they are not to consider matters affecting railways or traders as a whole but must concentrate on local matters of a general character, including freight and passenger service and collection and delivery and charges. Their powers are merely advisory and decisions are not binding on either the carriers or the shippers. The railways hope by means of these committees to bring about a closer understanding by each group of the other's problem and co-operation for improved service. The simultaneous move of the railways in both the great English-speaking countries toward closer relations with their patrons is indicative of the awakening of the railways to the importance of maintaining the friendship of the public—which should mean better service to shippers, a more general understanding of railway problems on the part of the public and, consequently, tangible benefits to the railways themselves.

Is everyone connected with train operation so absorbed in the problem of complying with the Government's edict about

Fatal Collision at Selden, Kansas automatic train stops that all other elements of collision-prevention are for the time-being forgotten? Sometimes it seems so. Every few weeks the Interstate Commerce Commission reports

a collision with the familiar statement "no block signal system was in use." These collisions are on lines which, evidently, are classed as secondary. Many of them belong to companies which have automatic block signals in use on large sections of their roads. The problem, as regards these collisions, is precisely the same as though automatic stops had never been heard of. And it is a problem. It cannot be ignored simply because there is another and bigger problem elsewhere. Moreover, it is a problem for the government as well as for the railroads; the commission has in past years referred to this problem of safety on lines which are destined to go without automatic signals for some years yet. At present the whole matter seems to have been lost sight of. A peculiarly regrettable collision is that which occurred at Selden, Kansas, on May 18, reported in another column. One fireman was killed. An engineman of 43 years' experience, running an important passenger train, in a fog, approached a station too fast, because he had "lost his bearings." The report indicates that he had no adequate land-

marks; that ostensibly, the manual block system was in use, while yet one of the simplest and most inexpensive features of the block system, a landmark to enable engineman in a foggy atmosphere to locate the end of the block section, was lacking. Fifty dollars' worth of white fence (the well known landmark used in Belgium) would, no doubt, have supplied the deficiency. Incompleteness of facilities may be justifiable, in proportion to lightness of traffic; but one who should put forth that argument in this case would have to consider whether it could be called a fair one, in relation to a line which is traversed at night by ten-car steel passenger trains at 45 miles an hour.

Thus far in the year 1923 the railways have not ordered as many new freight cars as in the same part of 1922, but

Locomotive Orders Exceed Last Year's they have ordered a much larger number of new locomotives. In the first five months of 1923 the number of new locomotives ordered was 1,598, as compared with only 460 in the same months of 1922. Additional orders placed in the first two weeks of June increased the total number of locomotives ordered up to that time to 1,684. The number ordered in the entire year 1922 was 2,600, which shows that two-thirds as many were ordered in less than one-half of the present year as in all of last year. The number of freight cars ordered in the first five months of this year was 65,699, as compared with over 77,000 in the same months of last year. Up to the middle of June total orders of freight cars were 67,209. The number of passenger cars ordered in the first five months of this year was 1,250, as compared with 1,195 in the same months of last year, and up to the second week in June the number of passenger cars ordered was 1,300. One reason why the orders placed for new equipment recently have shown a decline doubtless is that as a result of the large orders placed in the latter part of last year and the early part of this year there were on June 1 107,079 freight cars and 2,041 locomotives, which have been ordered, but not delivered. In the 17½ months which ended at the middle of June the total number of freight cars ordered was 248,181, the total number of locomotives ordered was 4,248, and the number of passenger cars ordered was 3,682. This was at the annual rate of about 176,000 freight cars, 2,850 locomotives and 2,500 passenger cars, and represents on the whole the largest orders for equipment placed by the railroads in an equally long period in more than 10 years.

Undoubtedly a considerable part of the \$425,000,000 which the railroads propose to spend in 1923 for transportation

Machine Tool Programs facilities other than cars and locomotives will go for new machine tools and equipment so badly needed in railroad shops and enginehouses. In fact some of the big machine tool programs laid out early in the year are already well under way, and in other cases the completion of the programs in the last half of the year will create an unusually heavy demand for railroad

shop tools. Evidently there is a growing appreciation among railroad men of the fact that money spent for shop machinery and tools is an investment which frequently pays high returns through the more prompt repair of equipment and its return to revenue-earning service. Among the high-production tools in railroad shops, the most prominent are driving and coach wheel lathes, axle lathes, car wheel borers, heavy duty planing, milling, slotting and drilling machines. Improvements in the latest types of these machines are sufficient to make them an attractive investment to replace earlier models which have outlived their effective use. In connection with the installation of railroad shop machine tools, the manufacturers are performing a valuable service by sending out demonstrators and service men to superintend the installations, instruct operators and even in some cases open the eyes of the local shop men to the possibilities in the way of production. Machine tool builders deserve great credit for the initiative shown in this direction and also in the development of new tools to meet the specialized railroad shop needs. It is gratifying to observe that railroad shop men are coming to know about and appreciate more fully the value of the engineering service offered by the manufacturers and are taking advantage of this service as one means of toning up shop operations and putting these operations on an efficient, up-to-date basis. It is said that if an industrial manufacturer handled his factories on the same basis as that on which some railroad shops are conducted competition would quickly wipe him out. Admitting the fundamental difference between an industrial manufacturing plant and a railroad repair shop, there is no doubt that this difference has been greatly over-emphasized and that it has been made an excuse for conditions which are now being gradually overcome.

In train operation innumerable occasions arise where a rule must be obeyed just because it is a rule, regardless of any

Careful Whistling at Crossings real or supposed temporary justification for not complying with it. A safety circular recently issued by the general manager of the Missouri-Kansas-

Texas, and noticed on another page,

calls upon locomotive runners to more carefully observe the rule to whistle at highway crossings, reminding them that a 31 days' checking, some months ago, showed that, in the cases recorded, 6 per cent of the enginemen did not sound the whistle. However, 94 per cent efficient is called a good record. Without questioning the facts or the reasoning on which this commendatory notation is based, we should like to ask any engineman or road foreman of engines if he is satisfied with 94 per cent. Of course, if one's permanent record were to depend on close adherence to the rule to whistle for all crossings, and the runners most neglectful were to have their names put at the bottom of the list, there would be no difficulty in making 100 per cent. The point we wish to stress is that a systematic purpose to accomplish 100 per cent, on the part of all the enginemen of a division or district, is necessary for simplicity of records and for the peace of mind of the superintendent. We may assume that the 6 per cent of enginemen, in that M.-K.-T. record, who did not whistle, were alert and could see the highway far enough in advance to be sure that no wayfarer was in danger—the officers of the road must have made some such assumption or they would not have called the record "good"—but if satisfactory records are to be kept and are to be of use, it is necessary to cut out all such indeterminate elements. To have comparable records which will be of value for future studies, and available for defense in case negligence is charged in a court, it is necessary to do a lot

of whistling which, from a narrow local and temporary point of view, may be wholly unnecessary. Somewhere, sometime, some engineman will assume that no whistle is needed and his assumption will prove to be wrong. Many a time an express train could make a hundred-mile journey, safe from derailment, if 10 per cent of the spikes in the track were gone; but the only business-like rule for the trackman is to keep 100 per cent of them in place all the time. Careless ears in the heads of automobile drivers, needing an audible warning every time they approach a railroad track, are now about as numerous as the spikes in the track. The engineman, like the trackman, must make his safety record by means of systematic attention to countless small details, with his thought centered on the one point of doing the duty, oblivious to any speculations about 99½ per cent being as good as 100.

The construction season is now at its height, and for the roads that started their work early in the year, fully one-half

Another Case of Priorities of the normal working period has already passed. It is, therefore, well to take accurate account of the progress made and with this as a measure, make careful estimates of the probable completion dates of all of the individual projects under way, since the results of such calculations may point to the need of the more intensive prosecution of some of them and the curtailment of others. The marked change in the relation of supply and demand for material and labor since the beginning of the construction season has seriously affected the progress of much of the work and the roads with large improvement programs are finding it impossible to meet the completion schedules set up at the inception of the work. Therefore, it has become a matter of weighing the relative urgency of the improvements and this may well be done by considering them under three separate headings. Under the first head may be considered individual building projects, such as passenger and freight stations, shops and storehouses the prosecution of which introduces no particular interference with the handling of traffic and which are of a nature that does not well permit of the entire temporary abandonment of the work. No general policy can be outlined for such projects. The urgency of each must be considered on its individual merits. In the second class may be considered additions and improvements to roadway, such as additional main, passing and yard tracks or grade and line revision designed to facilitate traffic and urgently needed for the heavy fall traffic movement and which, while in progress, may introduce serious interference with the handling of trains. In considering this class it is well to determine whether the continuation of the work after the middle of September may not cause more disturbance to traffic than its subsequent completion would justify. In many cases, it may be found desirable to concentrate on those sections of the improvements which can be completed by September 15, and postpone work on the remaining portions until next year. Under the third heading may be included all engine terminal projects designed to expedite the turning of locomotives, particularly during the winter months. These include the provision for additional stalls in roundhouses and improved heating systems and boiler washing facilities, and modern cinder pits and coaling stations. The extreme urgency of these facilities does not come until the advent of winter and, as a rule, prosecution of the work does not interfere seriously with transportation operations. Therefore, with five full months available in which to continue work on these projects, there is every reason to carry on with the objective of definite completion dates.

Two More Important Valuation Decisions

IN AN EDITORIAL in its issue for June 9 the *Railway Age* commented upon the decision of the Supreme Court of the United States in the valuation case of the Southwestern Bell Telephone Company. It will be recalled that in its decision in that case the court set aside a valuation placed by the Public Service Commission of Missouri on the property of the telephone company upon the ground that the commission "undertook to value the property without according any weight to the greatly enhanced costs of material, labor, supplies, etc., over those prevailing in 1913, 1914 and 1916." Some people interpreted the decision to mean that the valuation of a railroad or public utility must be based entirely, or almost entirely, upon the up-to-date cost of reproducing the property.

The *Railway Age*, in commenting upon the decision, called attention, however, to the fact that the valuation made by the Missouri Commission was set aside, because the commission "wholly disregarded" up-to-date costs. We said: "It would be a misinterpretation of the Court's opinion to say it held that the valuation of a public utility or railroad must be based entirely on up-to-date costs of reproduction. * * * All other elements that enter into the value of railroad or public utility property, as well as its probable cost of reproduction, must be considered."

Since this editorial was published the Supreme Court has rendered decisions in two other valuation cases which show that the interpretation placed by us on its decision in the Southwestern Bell Telephone case was sound. These are the cases of the Georgia Railway & Power Company, et al, Appellants, vs. Railroad Commission of Georgia, et al, and Bluefield Water Works & Improvement Company, Plaintiff in Error, vs. Public Service Commission of the State of West Virginia, et al.

In the Georgia case the public utility companies claimed that the rule to be applied in valuing the physical property of a utility is reproduction cost at the time of the inquiry less depreciation. It was shown that 1921 construction costs were about 70 per cent higher than those of 1914 and earlier dates, when most of the plant was installed. The Supreme Court refused to acquiesce in the claim that the valuation should be based entirely upon up-to-date costs of reproduction. It said: "The refusal of the commission and of the lower court to hold that for rate-making purposes physical properties of a utility must be valued at the replacement cost less depreciation was clearly correct." In other words, the present cost of replacement should have been considered, but the claim that the valuation should have been based on it alone was not allowed.

In the Bluefield Water Works & Improvement Company case the Public Service Commission of West Virginia found from an examination of the books that the records of the company clearly and satisfactorily showed the actual investment which had been made in its property. It then held "that when a plant is developed under these conditions the net investment, which, of course, means the total gross investment less depreciation, is the very best basis of valuation for rate-making purposes, and that the other methods above referred to (estimates of cost of reproduction, etc.) should be used only when it is impossible to arrive at the true investment." The Supreme Court said in its decision: "The record clearly shows that the commission, in arriving at its final figures, did not accord proper, if any, weight to the greatly enhanced cost of construction in 1920 over those prevailing about 1915 and before the war, as established by uncontradicted evidence, and the company's detailed estimated cost of reproduction new less depreciation at 1920

prices appears to have been wholly disregarded. This was erroneous. * * * This resulted in a valuation considerably and materially less than would have been reached by a fair and just consideration of all the facts. The valuation cannot be sustained."

The recent decisions of the Supreme Court in these valuation cases make certain important points regarding the valuation of railroads and public utilities perfectly clear. One of these is that no true and constitutional valuation can be based solely upon present day costs of reproduction less depreciation. Numerous other factors, including the actual investment in the property as far as ascertainable, must be considered. Secondly, however, no true and constitutional valuation can be based solely upon the actual investment in the property, even though it is completely and accurately ascertainable. The up-to-date cost of reproduction must be given much, although not exclusive, consideration. The decision in the Bluefield case clearly and finally disposes of the claim advanced by the recent conference on valuation held by the "progressives" in Chicago that the valuation of the railways should be based entirely upon the actual investment in them. This was the decision actually reached and clearly stated by the Public Service Commission of West Virginia in the Bluefield case, and it was just as clearly and definitely overruled by the Supreme Court.

These decisions show that the Supreme Court does not now depart in the slightest degree from the principles laid down by it in the case of Smythe vs. Ames (Nebraska Rate Case) in 1897, and in many decisions since then. It held then, it has held ever since, and it holds now, that in making a valuation of a railroad or public utility the authority making it must take into consideration the actual investment which has been made in the property, its present cost of replacement, and all other elements entering into its value.

The railroads, in view of these decisions, have no reason for apprehending that if the Interstate Commerce Commission places upon their properties valuations which ignore the high costs which have prevailed within the last ten years, the Supreme Court will sustain it in so doing. On the other hand, the public need not feel any apprehension that a legal valuation can be made entirely upon the basis of the high costs which have prevailed, especially during the last seven years. It has been said, and no doubt correctly, that a valuation of the railroads based upon present day costs would amount to 35 or 40 billion dollars. The railroads have been attacked upon the ground that they have been seeking a valuation upon this basis. The recent decisions of the Supreme Court show that even if they should seek a valuation upon this basis they would not get it.

The railroads need not feel pessimistic because the Court has held that, while present costs must be considered, valuations cannot legally be based upon them exclusively. A valuation based entirely upon the present cost of reproduction would be so large that it would arouse a hostile public sentiment which, in the long run, would do the railroads more harm than good. What the railroads need, and all they need, is a valuation, and a net return upon that valuation, which will enable them to pay their interest and reasonable dividends, and build up reasonable surpluses, and thereby enable them to raise sufficient new capital to provide the country with adequate transportation service. It is just as essential to the welfare of the public as it is to that of the railroads that they should be given a valuation and allowed to earn net returns which will have this effect.

It must be said that the recent decisions of the Court have emphasized the difficulty and complexity of the work of making a valuation. If it could be based upon a single factor, such as the estimated investment or the estimated cost of reproduction, the task would be a comparatively simple one, but it must be based upon numerous factors, and in

order to base it on all these numerous factors the government authority making the valuation must assemble a very large amount of information of various kinds, and then exercise a sound judgment in arriving at a final conclusion. This exercising of a sound judgment, however, is, after all, the very essence of solving the problem of what is the value of a property.

The two more recent decisions, like that in the Southwestern Bell Telephone Company case, also emphasize the fact that the Interstate Commerce Commission, in the final valuations which it has announced thus far, has not been giving sufficient consideration to present day costs of reproduction. When it does give sufficient consideration to them it will make most of these valuations larger. But it does not seem probable that the final aggregate valuation of all the railways will be so large as to justify complaints regarding the rates based upon it.

An Important Association and Its Opportunities

THE CONVENTION of the American Association of Railroad Superintendents, which was held at Kansas City, Mo., last week and the report of which appears in another column, left much to be desired, particularly with respect to the attendance. The presence of less than 10 per cent of the membership is disappointing, particularly in view of the fact that the problems now confronting the railways are primarily those of transportation. This small attendance was due to some extent to the cancellation of plans by members who were confronted with floods and other emergencies at the last minute. It was also a result of the inevitable loss of interest following a period of suspended activities. However, it is even more a reflection of the lack of interest in the program which was presented.

While the association was favored with the presentation of addresses of unusual merit and timeliness by a number of prominent railway officers, the reports of the regular committees were of so little interest to the members that with one or two exceptions they were presented by title only and received no discussion. This condition was brought about by the fact that it was seven years since the last meeting of the association was held. During that interval many subjects were brought to the attention of the officers and referred to committees for investigation and report. Although the occasion for a study of most of these subjects is now a matter of the past, the reports were incorporated in the program and scheduled for consideration. On the other hand, no attention was given to the American Railway Association program to meet the transportation crisis this fall or to numerous other topics which are confronting transportation officers at the present time. The fact that the members were eager to discuss live topics was indicated by the reception given the report on the substitution of the 19 order for the 31 order. It is to be regretted that such topics as long engine runs, main trackers, more miles per car per day and heavier car loading were not discussed at length, for it is these problems which transportation officers are facing and which offer the greatest opportunities for improvement in methods, and it is to be hoped that the officers of the organization give such subjects primary consideration next year.

No railway association has a greater opportunity for service than the American Association of Railroad Superintendents. Its membership is comprised of those railway officers who are in charge of the manufacturing operations of the railroad. They produce the one thing which the railways

have to sell and it is their problem to produce that product in sufficient quantity to meet the demands of the public, while at the same time holding their expenditures to the minimum. This association deserves the wholehearted support of every railway executive. He owes it to his railroad to encourage his transportation officers to affiliate with this association, to participate in the work of its committees and to attend its conventions. Now that the railways are returning to more normal conditions, it is to be hoped that the association may be able to carry on its activities without further interruption in order that the railways as a whole may benefit from its deliberations.

New Books

A List of New Books and Special Articles of Interest to Railroaders

(Compiled by Elizabeth Cullen, Reference Librarian, Bureau of Railway Economics, Washington, D. C.)

Books

By Camel and Car to the Peacock Throne, by E. Alexander Powell. Describes existing means of transport, including occasional railroads, in Asia Minor and Central Asia. 329 p. Published by Century Co., New York.

The Far Eastern Republic of Siberia, by Henry Kittredge Norton. Railroad history in Chapters 2-4. Present situation, Chapter 17. Shatov, the transport minister, was formerly a strike organizer. 310 p. Published by G. Allen & Unwin, London.

Industrial America in the World War. The Strategy Behind the Lines, 1917-1918, by Grosvenor B. Clarkson. What Willard, Lovett, Powell, and other railroad executives accomplished as the railroads' share. More particularly Chapters 2, 4, 9, 10 and 29. 573 p. Published by Houghton-Mifflin, Boston and New York.

Report on the Economic, Financial and Industrial Conditions of the U. S. of America in 1922, by J. Joyce Broderick. A convenient "What happened in 1922." 206 p. Published by Oxford University Press, New York.

Periodicals

The Canadian National Railways, by D. A. MacGibbon, Professor of Political Economy, University of Alberta. Annals of the American Academy of Political and Social Science, May, 1923, p. 131-135.

Financial Investigation of the Prospects of Railway Electrification, by Sir Philip Dawson. Applied chiefly to Gt. Brit. and the continent. Interesting maps and charts. Journal of the Institute of Transport, June, 1923, p. 279-300.

French Road to Tap Heart of Africa. Trans-Sahara Seems Assured, by Warre B. Wells. New York Tribune, June 17, 1923, 2d news sect., p. 1, col. 6.

The Mid-West Traffic Jam, by Hugh J. Hughes. Development of waterways as one means of relief. Nation's business, June, 1923, p. 30-32.

Rail Freight Rates and the Development of Lake Ports, by William H. Adams. World Ports, June, 1923, p. 17-26.

Railroad Consolidation, by Alexander W. Smith, Special Counsel, U. S. Railroad Administration. Shipper and Carrier, June, 1923, p. 181-182.

Twentieth Century Medievalism, The Machine Age on its Way to a New Order? by Charles Merz. Suggestion that super-power development will hasten de-centralization of industry through improved machinery and transportation. Century Magazine, June, 1923, p. 228-236.



The Structure is Efficiently Lighted as May Be Judged from this Night View

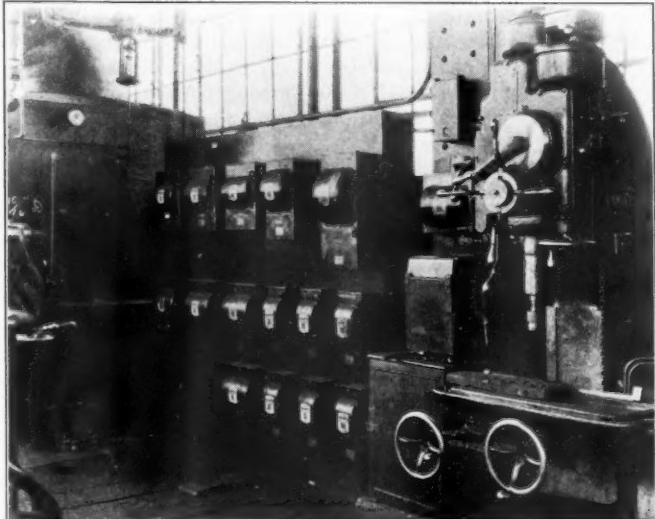
New Mallet Shop Has Interesting Features

Western Maryland Completes Modern Unit at Port Covington, Md., for the Repair of Heavy Power

THE WESTERN MARYLAND has recently completed and put into service a new shop at Port Covington, Baltimore, Md., containing many features of design and equipment of considerable interest. Measuring 100 ft. by 300 ft., it is built entirely of steel and glass on concrete founda-

tive effort of 100,800 lb. when working compound and 121,000 lb. when working simple. These locomotives are used regularly in the road's "turn-around" service between Hagerstown and Baltimore. The repair of these Mallets having become an important problem, it was decided to erect a shop of sufficient capacity to insure their regular and proper repair with adequate provision for additional power of the same class or of other classes.

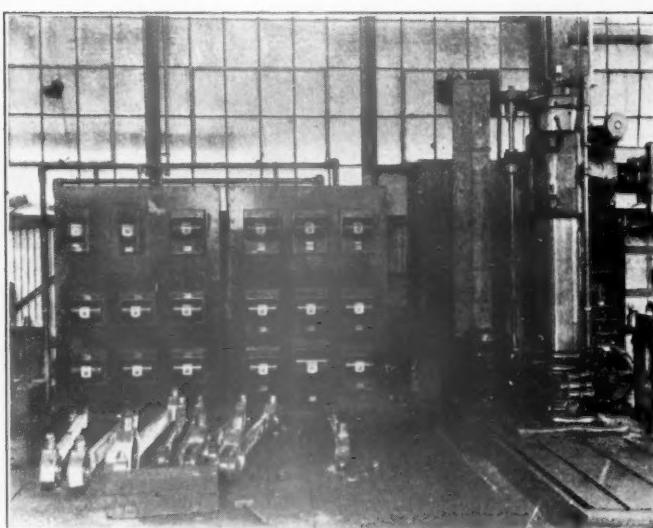
Figuring on a basis of one Class 3 repair each year for each Mallet, the resulting average was slightly over two locomotives per month. It was, therefore, decided to build a



Safety Switch Installation with Heater Installation at Left

tions, is fully equipped with electrically-driven machinery and contains three erecting tracks for the repair primarily of Mallet locomotives. Generous provision has been made for space and lighting with the result that efficient shop operation has been easily secured.

The new shop is the result of a distinct need for modern facilities at the eastern terminus of the Western Maryland for the repair of heavy power. At the present time this road has 25 Mallet locomotives of the 2-8-8-2 type with a trac-



All Machine Tools Have Individual Safety Switches—A Typical Bank of Switches

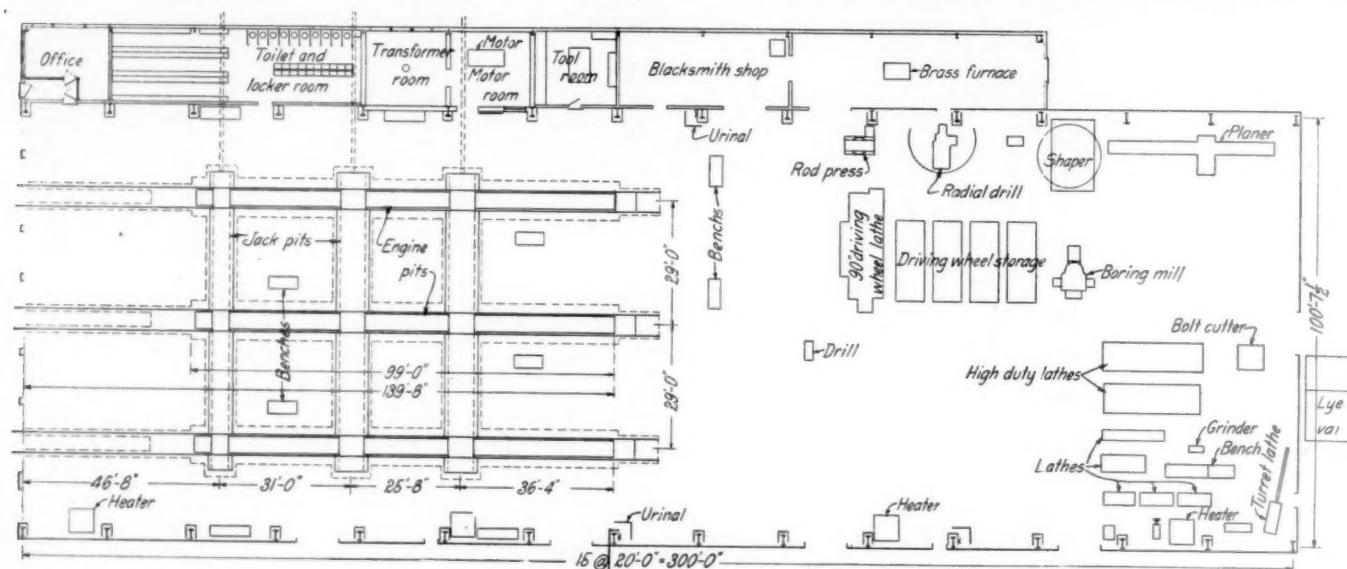
shop having three tracks. As an indication of the capacity and efficiency of the shop, the following repairs were made during the months of April and May with less than 100 men

employed. This work was done with the equipment in place at the time as shown on the illustration, and previous to the installation of seven additional machines now under way.

APRIL	
3	Class 3 repairs (Consolidation or other power)
3	Heavy running repairs (Mallets)
MAY	
1	Class 3 repairs (Mallet)
2	Class 3 repairs (Consolidation)
1	Class 4 repairs (Consolidation)
1	Class 5 repairs (Consolidation)

Design of the Structures

The new shop adjoins the present engine terminal at Port Covington, being served by the same turntable and trackage.



General Arrangement of the Shop and Equipment

It is 100 ft. wide by 300 ft. long, inside dimensions, with a clearance from floor to roof trusses of 45 ft. With the exception of one corner of the building which extended beyond the limits of the shore, the building is carried on mass concrete foundations. Under the corner mentioned, piling was driven and concrete pedestals poured to carry a reinforced concrete

beam construction upon which the steel superstructure was supported, after which the area in and around this part of the building was filled in and shouldered out. The superstructure consists of 45-ft. steel columns spaced 20 ft. center to center along the sides and designed to carry a 15-ton overhead crane for the full length of the building as well as the steel roof trusses of 100-ft. span. An 18-ft. lean-to, 240 ft. long, adjoins the water side of the structure. The roofing consists of tongue and grooved timber overlaid with tar and gravel. Corrugated sheet iron was used in the ends and side walls as sheathing between the wide expanses of sash.

Adequate day-lighting has been secured by the generous use of steel sash windows in the sides and ends, all with



An Interior View of the Pit End of the Shop

roof of the lean-to and one line in the side wall of that structure. The incoming end is arranged with four lines of five-light sash above the doors of which there are five of rolling steel. The three doors for the locomotive tracks are 16 ft. wide and 17 ft. high. Two intermediate doors are 10 ft. wide and 14 ft. high. The rear end of the building has five lines of sash, and one 10-ft. by 14-ft. rolling steel door giving access to a 9-ft. by 9 ft. concrete lye vat situated just outside the building.

Arrangement of the Equipment

The interior of the building is divided into two sections, a three-track pit section for the locomotives, and the machine shop, approximately 180 ft. and 120 ft. in length respectively. The longitudinal or engine pits are 99 ft. long, interconnected with three drop pits for the simultaneous dropping of wheels and are constructed of concrete reinforced with steel rails. These pits are completely piped and wired for water, air, gas and electricity with numerous convenient outlets. Gas is used as fuel for rivet heaters, brass melting, tire heating and other purposes. Thirty-ton pneumatic jacks are used in the drop pits for unwheeling. The flooring in this section of the building consists of eight inches of concrete.

The machine shop section is floored with 4-in. oak plank. In addition to the tools shown in the illustration, seven additional machines are being installed as follows:

- 1 Libby turret lathe
- 1 Dill slotted
- 1 Woodward & Powell crank planer
- 1 Worcester grinder
- 1 Chambersburg hammer
- 1 Bullard boring mill

Electric Light and Power

All machines are arranged so that the work may be handled in a progressive cycle, obviating as far as possible any back movement of the parts to be repaired. Each unit is direct-driven by electric motors with independent controls and safety switches. Other equipment and facilities are housed in the lean-to in which are the blacksmith shop, the brass furnace, the tool room, the lavatories and lockers, and electric converter and transformer units located in two fireproof rooms constructed with brick walls. Power is purchased from the city at 13,000 volts 3-phase, 25-cycles and is converted by a rotary converter set to 220 volts d.c. for certain of the machine tools. Incoming current is also stepped down to 500 volts a.c. for other tools and other uses. Several installations of power and lighting panels have been made at various points about the shop.

The provision for artificial light has been well arranged by a system of overhead and sidewall reflectors augmented by individual lights at all machines and in the pits, plus a generous installation of outlets within the entire building. The main lighting system consists of 500 watt overhead reflectors spaced 20 ft. center to center in two arrangements. In the machine shop end there are five longitudinal lines of this size of lights with overhead reflectors while in the pit end of the building there are three lines overhead and two lines of sidewall reflectors.

Adequate heating of the building is obtained by the use of four Baetz No. 6 heaters, each containing about 3,000 ft. of steam coils around which air is forced by fan motors and discharged at the top. These heaters are all located along one wall, the discharge funnel throwing the heated air across the shop and causing a circulation that has given entirely satisfactory results.

Both the concrete and oak plank floor have aisles or runways marked off with paint, over which an electric truck equipped with a 3,000-lb. boom crane is operated for the handling of material. These aisles are connected with an outside concrete runway leading to a 36-ft. by 100-ft.

standard steel building which serves as a storeroom and is fully equipped with modern steel racks, etc.

For the convenience of the shop forces and likewise to conserve time numerous installations of iced coil drinking fountains have been made at intervals along the side walls of the building. A similar plan has been followed in regard to toilet facilities, a number of screened-off urinals having been installed along the walls of the shop proper in addition to the facilities in the locker room.

The design and construction of the new shop was carried out by the engineering department of the Western Maryland, H. R. Pratt, chief engineer, under the immediate supervision of C. B. Hoffman, Jr., assistant to chief engineer. The steel superstructure was furnished by the McClintic-Marshall Company, Pittsburgh, Pa., and erected by M. A. Long, contractor, Baltimore, Md. The contractor for the sash was the Truscon Steel Company, Youngstown, Ohio. The heating, plumbing and electrical work was installed by the Riggs, Distler Company, Baltimore.

Board Condemns Labor Policy of Pennsylvania

A DECISION officially censuring the Pennsylvania for its stand in upholding its employee representation plan and refusing to recognize the national labor organizations as the representatives of its employees, has been made public by the Labor Board. Under its power to report any violation of its decisions, the board "finds that the Pennsylvania system has violated decision No. 218 of the board, after the Supreme Court of the United States has upheld the board's right to render such a decision, and has thereby denied to its shop employees essential rights as laboring men to which Congress has declared them entitled."

In refusing to obey decision No. 218, in which the Labor Board ordered that representatives of the shop employees on the road be chosen as members of any labor organization, as well as individuals, the Pennsylvania maintained that this action was contrary to the wishes of the majority of its employees, and disputed the right of the Labor Board to order a new election. An injunction, which the Pennsylvania secured to prevent publication by the board of a decision declaring that the road had violated a lawfully rendered order, was dissolved by the Supreme Court of the United States on the ground that the board was acting entirely within its power.

The opinion published by the board with its decision follows:

The course adopted by the Pennsylvania system in this matter is indefensible from every viewpoint. It cannot be justified on the ground that the contention of the employees or the decision of the board deprived the carrier of the right to deal with its own employees. System Federation No. 90 was composed exclusively of employees of the Pennsylvania system and their officers and representatives were employees of the carrier. If, in rare instances, these local representatives of the employees availed themselves of the advice and assistance of the officers of their national organization or of other counsel, this would have been the exercise of a fundamental right. The board's decision did not require the carrier to negotiate with System Federation No. 90 or any other organization, but merely accorded to employees the right to choose between System Federation No. 90 and the organization set up by the carrier.

The plan called "employee representation" which the Pennsylvania system assumes to have originated, is guaranteed in the Transportation Act of 1920 and prevails on the railroads throughout the United States. If employee representation means anything at all, it signifies the right of a class of employees, through majority action, to select their own representatives to negotiate with the carrier agreements covering wages and working conditions. This is what congress said it meant, but the shopcrafts have so far been deprived of this plain, simple, indisputable right

on the Pennsylvania system. The carrier has not questioned the right of these employees to choose their own representatives, but it has prevented the exercise of this right. While professing its acceptance and observance of the principle of employee representation, it has set up a system which throttles the majority and establishes the representation of a coerced and subservient minority proven originally to amount to about 10½ per cent of this class of employees.

While the carrier was refusing to deal with the organization of the shopmen and that of the clerks, as such, it negotiated agreements with the train and engine brotherhoods, which they signed officially as the representatives of those organizations. If the same right had been accorded to the shopmen, this controversy would never have existed.

The problem of efficient and uninterrupted railway transportation is of paramount importance to the people of this country. The peaceful adjustment of labor controversies greatly contributes to this end. The method provided by Congress for settlement of labor disputes has been honored and observed both by carriers and employees in an overwhelming number of instances. The railroad which refuses to conform to the labor provisions of the Federal law assumes toward the public the same attitude held by employees who strike against said provisions. No other railroad in the United States has taken a position similar to that adopted by the Pennsylvania in this case.

Wage Increase Hearing Closes

The Labor Board hearing on the petition of the Brotherhood of Maintenance of Way Employees and Railway Shop Laborers for wage increases for the employees it represents on over a score of roads throughout the country, closed on June 13, following specific objections to the proposed increases by representatives of the defendant roads. The managements contended that an increase at this time is not necessary, because the cost of living has not increased to an appreciable extent.

Speaking for the western roads represented before the board, J. W. Higgins, chairman of the General Managers' Association of Chicago, declared that the exhibits presented by the brotherhood relating to wages and living costs seemed to have been gathered in the large cities in the east and central west and were, therefore, wholly different from and not fairly comparable to those of the small towns and rural districts. Mr. Higgins said in part:

"We believe that wage scales should be based on living costs under related conditions in each locality. In previous hearings before this board we asked that such conditions be brought about because common labor rates do vary as between cities, towns and rural districts in the same latitude and are influenced by climate and different latitude. The recent agreement established differentials to meet some of these conditions. The agreements made since March 1 disposed of wage demands identical with those now being heard. Three important factors stand out in these western settlements: They run for one year; i.e., they run for one year and thereafter subject to 30 days notice. They provide differentials as between localities and more experience, thus recognizing the apprentice feature, and they permit the fixing of temporary or seasonal rates for emergency conditions.

In considering each of these railroads, we ask that the board give due weight to the fact that this organization agreed to and established rates for men in like service on other railroads in the same territory much below what it asks your board to grant, that in parts of the territory through which these roads operate, agreements were made that did not increase all rates. Settlements on the great majority of the western roads show a belief on the part of both men and managers that all factors in the Transportation Act have been satisfied and they expect no disturbing fluctuation in two factors, i. e., outside wages and cost of living.

We submit that it is self evident that all these cases cannot be given the same treatment; therefore, we respectfully request the board in disposing of each case, to consider the situation presented by each individual road separately and to apply to each case only such evidence as gives the wage and living conditions in its territory. We ask for a separate decision for each of these roads because each presented its own relevant conditions and deems it of great importance to future peace and harmony that your decision be based upon the conditions in and of localities along the line of each road.

As the result of the meetings last April of all general chairmen in the Brotherhood of Railway and Steamship Clerks, negotiations are now under way between the brother-

hood and a number of roads for wage increases to clerical employees ranging from five to 13 cents an hour. The increases which are sought are as follows: Clerical supervisory forces, seven cents an hour; clerks with over one year's experience, seven cents an hour; clerks with less than one year's experience, 6½ cents an hour; callers, gatemen and baggage room employees, three cents an hour; janitors, watchmen and switchboard operators, 10 cents an hour; office boys, five cents an hour; freight handlers or truckers, six cents an hour.

Among the roads which have received these demands are the New York Central; the New York, New Haven & Hartford; the Missouri Pacific; the Baltimore & Ohio; the Cleveland, Cincinnati, Chicago & St. Louis; the Michigan Central; the New York, Chicago & St. Louis; the Boston & Albany; the Boston & Maine; the Lehigh Valley; the Lake Erie & Western; the Maine Central; the Pittsburgh & Lake Erie; the Rutland; the Minneapolis, St. Paul & Sault Ste. Marie; the Kansas City Southern, and the Duluth, South Shore & Atlantic.

General chairmen of the Brotherhood of Railway Trainmen and the Order of Railway Conductors will meet on July 9 to consider increased wage schedules and new working rules to be requested in the fall when the present rates and rules agreements expire. The Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen will negotiate separately. The nature of the new demands have not yet been disclosed.

The Long Island has granted increases in wages to its 3,000 maintenance of way employees as follows: Bridge and building foremen, section foremen and assistants, a five per cent increase; mechanics and mechanics' helpers, three cents an hour; pile drivers and ditching engineers, two cents an hour; crossing watchmen, \$5 to \$6 a month, telegraph forces, three cents an hour.

The New York, Chicago & St. Louis and the Lake Erie & Western have granted an increase of three cents an hour to mechanics' helpers and apprentices in the shopcrafts. Approximately 2,400 employees are affected. The San Antonio & Aransas Pass has also granted a three-cent increase to the same classes of employees.

The Brotherhood of Railway and Steamship Clerks has filed a submission with the Labor Board asking increases of from five to nine cents an hour for the employees it represents on the Seaboard Air Line.

The Atchison, Topeka & Santa Fe has presented to the board a joint submission in a dispute with the Brotherhood of Railroad Signalmen of America involving requested wage increases. The rates of pay which are sought are as follows: Gang foremen, \$1 an hour; leading signalmen and signal maintainers, 90 cents an hour; signalmen and signal maintainers, 85 cents an hour; assistant signalmen and signal maintainers, 70 to 76 cents an hour, varying according to length of service, two cents per hour being added for each six months' accumulated service; helpers, 60 cents an hour.

SEEING A SMASH-UP.—Life is too short and too sweet to take blind chances at grade crossings, when it is so easy to make sure. This is the advice of the Standard Oil Company in its advertising campaign to sell to automobilists greater quantities of gasoline. Continuing, the ad writer says: "I saw a smash once, and that was enough for me. No more taking chances for Yours Truly, or 'hoping' there isn't a train coming. You can't absolutely trust anything but your own eyes to tell you whether the track is clear or not. The flagman may not be on duty when you happen along. The automatic signal may be out of order. The train may be coasting quietly down a grade toward the crossing. There are a dozen 'mays,' and 'may nots,' and 'ifs.' No siree! My tip is: Always assume there *is* a train coming. It is better to be wrong than to have your picture in next day's paper—'Victim of Auto Wreck.'"



Railway Accounting Officers and Guests, Richmond Meeting

Railway Accounting Officers Meet at Richmond

Simplification and Standardization Leading Features—
Revision of Classifications Under Way

ABOUT 400 ACCOUNTING OFFICERS attended the thirty-fifth annual meeting of the Railway Accounting Officers Association held at the Hotel Jefferson, Richmond, Va., June 13 to 15. Addresses were made at the meeting by W. J. Cunningham, professor of transportation at Harvard University and by W. H. Williams, vice-president of the Delaware & Hudson and chairman of the board of the Wabash. Professor Cunningham's paper on the subject of the accounting and statistical requirements of the Interstate Commerce Commission was published in last week's issue of the *Railway Age*, page 1463. Mr. Williams spoke also on the general subject of statistical analysis and his paper may appear in a later issue of the *Railway Age*. If the thirty-fifth annual meeting could be said to have a theme, it was the attention paid to the desirability of standardization and simplification in railway accounting, this indicating the continuance of the degree of attention and importance which the R. A. O. A. has directed towards this feature of accounting work. The association is continuing to give attention to the subject of the statistical and accounting requirements of the public regulatory bodies and a feature of the meeting was the statement of the conclusion reached by the Committee on General Accounts that the requirements have not been as severe as many have thought, nor is there as much room or desirability for a reduction in these requirements as many may have expected. For the past two years the association has had a committee working with the Bureau of Accounts of the Interstate Commerce Commission relative to a proposed revision of the operating expenses classification. This work was continued during the year which closed with the present meeting, but the report submitted by the committee was in the form of a progress report, the proposed revision classification not having been as yet brought to that stage where it is ready to be offered for general discussion. Announcement was also made that a sub-committee had been appointed to collaborate with the Interstate Commerce Commission on a revision of the classifications of operating revenues, investment in road and equipment, income, profit and loss, and general balance sheet statements.

The R.A.O.A. annual meeting was conducted in the usual manner which the association has followed for the past few years. The method followed in the work of this association is roughly as follows: There are a small number of important standing committees, the more important being the Committee on General Accounts, that on Freight Accounts,

that on Passenger Accounts, and that on Disbursement Accounts. The first has 25 members and the other three have 21. There are also committees dealing with the subject of overcharge and agency relief claim rules, with terminal companies' accounts, with statistics, etc. Each of these committees meets at various times during the year, the secretary of the association serving also as secretary of the individual committees. Each committee discusses a wide variety of subjects in its field. This year the Freight Committee reported on 77 subjects, the Passenger Committee on 38, and the Disbursement Committee on 35. The members of the association are kept informed currently insofar as is necessary of the work carried on by the various committees and prior to the annual meeting there is sent to each member a copy of the Agenda, containing the reports of the several committees. The Agenda this year was a book of over 300 pages. Another interesting feature of the annual meeting is a plan whereby each of the committees meets on the day prior to the beginning of the annual meeting itself to which committee meetings all members of the association are invited and at which meetings the report of the committee is discussed in great detail. Any changes that may be made as a result of this discussion are prepared in the form of supplementary agenda and presented to the members in mimeograph form. As a result of this procedure, the work of handling the detailed committee report on the floor of the meeting itself is expedited and discussion is held to a minimum without, on the other hand, there being any danger that points needing discussion should be overlooked. Because the report is available in the Agenda, it does not become necessary to read it on the floor of the meeting, although it is the practice in the case of important subjects for the chairman of the committee to call upon one of the members to explain the action taken and to answer questions. The result of this procedure is shown in the fact that while the Committee on Freight Accounts reported on 77 subjects and the report required 114 pages of the Agenda, adequate discussion of all this material was had in but about three or four hours of the meeting's time.

The sessions of the R.A.O.A. thirty-fifth annual meeting were presided over by the president of the association, L. G. Scott, vice-president of the Wabash. In the president's address, Mr. Scott pointed out some of the high lights in the work which the association had been carrying on. He referred to the feature of standardization and simplification of

accounting work. The association has recently made a considerable share of its rules mandatory. Mr. Scott referred to the importance of this procedure and emphasized the desirability that changes in the mandatory rules should be kept, insofar as possible, at a minimum, only those changes being made which will prove of importance and relatively long

standing. A point of particular interest in the address was a report recently made by the Division of Simplified Practice by the Department of Commerce, complimenting the Railway Accounting Officers Association on its efficient and able organization. Mr. Scott's address to the convention follows in part:

President's Address

The Governmental Department of Commerce, of which the Honorable Herbert Hoover is Secretary, has a Bureau of Service connected with his department, which he himself organized and designated "Division of Simplified Practice" for the purpose of making studies of the practices of manufacturers, producers, etc., in the hopes of securing their co-operation in the effort to eliminate unnecessary operations and to use simplified practices that produce economy and resulting in reduced prices to the consumer. The Division of Simplified Practice tendered its services to our association which we promptly availed ourselves of to the extent of inviting the representatives of the Division to visit the Association's office, look into our methods and accomplishments, and make such suggestions as would tend to aid the association, based on the division's experience with so many industries and the varied commercial associations.

After completing the investigation, the representative departed with an oral statement to the effect that he had come with the expectation of making suggestions to us, but he was leaving with the realization that the methods and results of the association were model and worthy of commendation; that the experiences of the Division did not indicate any suggestions whatever that could be made for the improvement of the methods and work being carried on by the association. Later the following letter, dated March 29, 1923 and signed by the chief of the Division of Simplified Practice was received:

"Since talking with you on March 23d about the simplification and standardization activities of your association, I have reviewed your manual of Railway Accounting Procedure, your 38th annual report, and the other descriptive matter you so kindly furnished this office. Comment from us, in recognition of the splendid achievement of the Railway Accounting Officers Association, in simplifying interline practice, is superfluous, for the results of the open-minded attitude and constructive policy of your members speak for themselves. Nevertheless, we are glad to have this opportunity to compliment you on the success of your efforts, and to express our appreciation of the national service you are rendering by eliminating waste in the industry with which you are so closely concerned."

While I know you join me in being proud of what the association has accomplished during the past year, yet the view for the future, as I see it, disclosed through my touch with the association and its work during the past, particularly the year just closed, leads me to the opinion that we have, as it were, but just started, and achievements that will be of more real value to those whom we serve are still before us to be accomplished.

One of the most important if not the most important, steps ever taken in the history of railway accounting was the adoption by this Association of Mandatory Rules covering certain phases of interline accounting and certain interline forms. Those rules represent merely a fair, impartial procedure of accounting among carriers for their interline dealings, and are the result of many years' study of practically every kind of accounting situation, and as a matter of fact, they are really composed of what has been for many years standard interline accounting practices.

Those who are familiar with the tendencies of the times readily recognize that perpetuation cannot exist for those conditions which have made it possible for a carrier to deviate from an interline accounting rule according to the whim of the moment or according to its interest in the individual case, while, under other circumstances, the same carrier could insist on making a literal application of the same rule when its interests lie in that direction. Demanding the return of those conditions would be like demanding that the dead leaf be returned to the tree.

Of course, the rules are not perfect, and they do not represent the fixed and unalterable practice for all time to come. On the contrary, it is entirely clear that experience, added wisdom and new viewpoints will, from time to time, indicate changes, alterations and additions that may well be made.

I feel, however, that the rules and the forms should only be changed when there is a controlling or impelling reason of general application to warrant such change. The rules should never be altered merely to meet some individual situation, and we may well recognize the principle that it will be necessary to adapt the individual cases to the rules—rather than undertake the impossible proposition of adapting the rules to the exceptional individual cases.

Standardization and Simplification

Some very substantial results in the way of standardizing and simplifying railway accounting forms have been accomplished in recent years by the association. This is a field of endeavor that affords many opportunities for constructive efforts and is a work that saves money for the railroads in reducing printing costs and in producing increased efficiency and economy in clerical labor. I am glad to see that our committees are continuing their commendable efforts in this direction.

I commend to your notice, and for action by the various committees of the association, the subject of nomenclature or terminology, that is to say, the definition of words, phrases, etc., that are in common use and have some meaning peculiar to railway accounting. This is a subject that may well receive the necessary attention and action. It has been suggested before, but it will bear repetition.

The work of the association during the past has been confined largely, in fact almost entirely, to matters relating to interline accounting, that is to say, accounting affecting two or more carriers, thereby creating an erroneous impression, for while interline accounting has constituted a large part of the association's work, for the very natural reason of its outstanding importance, the association will continue to welcome and act upon suggestions for ideas relating to accounting practices, methods and forms, whether interline or local.

The interchange of ideas and suggestions on such subjects through the medium of the association proves of benefit and assistance, and we must constantly bear in mind the advantages incident to having recommendations and suggestions along these lines become a matter of record in the association's publications and thus be available for reference when the need arises.

Report of Committee on General Accounts

The report of this committee covered 19 subjects and was presented by its chairman, J. G. Drew, vice-president of the Missouri Pacific. Among the important subjects covered were the following:

Revision of I. C. C. Accounting Classifications

At this meeting in 1922 in Cleveland, the association referred to its Committee on General Accounts for further consideration recommendations of the Committee on Disbursements Accounts with respect to the revision of the classification of operating expenses and expressed its conclusions as being in favor of abridging the number of primary accounts. Representatives of the Interstate Commerce Commission had suggested that the classification should require a sub-division uniformly to be made by all carriers of charges for labor, fuel, material and miscellaneous items. Discussion of the subject was had with representatives of the commission by a sub-committee representing the Accounting Officers Association of which John Hurst, assistant comptroller of the Pennsylvania Railroad, was chairman. The work of this sub-committee was not completed in time for presentation for the 1923 meeting and discussion of the proposed revision of the classification is still being carried on.

Revision of the Classifications of Operating Revenues, Investment in Road and Equipment, Income, Profit and Loss, and General Balance Sheet Statements.—A sub-committee headed by J. J. Ekin, comptroller of the Baltimore & Ohio, has been appointed to collaborate with representatives of the Interstate Commerce Commission with reference to these matters.

In the Supplementary Agenda the Committee on General Accounts reported its approval of the following suggestions made by C. E. Hildum, comptroller of the Lehigh Valley, with reference to the manner of showing the item of net railway operating income in the income account statement. Mr. Hildum's suggestion was as follows:

"In order to make our income account statements more easily understood, we have for a considerable period eliminated the item of operating income as a subtitle, and have grouped the following four accounts under the heading of 'Deductions from revenue':

532	— Railway Tax Accruals.
533	— Uncollectible Railway Revenues.
536-540 }	— Equipment Rents—Net.
508&541	— Joint Facility Rents—Net.

"The total of these four items deducted from 'Net operating revenue' gives us 'Net railway operating income.' It is, of course, necessary to show 'Equipment rents—net' and 'Joint facility rents—net' in red when the balance is a credit to revenue.

"Since the item 'Net railway operating income' is now of paramount importance, it seems to me that this form of income statement is preferable to the old form, and I would suggest that the question be referred to the appropriate committee for presentation to the Interstate Commerce Commission when the revision of the classification of income accounts is considered."

Operating Statistics—Number of Car Miles By Direction of Movement

The following recommendation was adopted in response to a question raised by Dr. M. O. Lorenz, director of the I. C. C. Bureau of Statistics, as to whether or not the practice in operating the direction of traffic originating on branch

Report of Committee

The report of this committee covered 77 subjects. It was presented by T. H. Seay, auditor freight accounts, Southern Railway. The committee reported that it had held during the year four meetings covering a total of 12 days. Among the important subjects discussed were the following:

Revision of R. A. O. A. Standard Forms

To discuss this subject the chairman called upon A. J.

lines is the same on all roads: "Report all car miles moving from a branch line to the main line as eastbound (or northbound); and all car miles moving to a branch line from the main line as westbound (or southbound), regardless of the direction of movement of such traffic on the main line."

Value of a Unit of Equipment As Rebuilt

The report presented a number of letters from Alexander Wylie, director of the I. C. C. Bureau of Accounts, relating to this subject and advised that the matter had been placed before the sub-committee that is working on the revision of the operating expenses classification.

Modifying Monthly Wage Statistics

The General Accounts Committee report reproduced suggestions offered to the Interstate Commerce Commission as to proposed modification in the form of the monthly wage statistics report with comment on the suggested changes by the secretary of the Bureau of Information of Eastern Railways. There was also given a copy of a letter addressed by the R. A. O. A. to the commission and the Labor Board in which, among other things, appeared the following comment:

The position taken by the accounting officers with respect to the revision of wage statistics is that the following should be considered:

1st: The usefulness of the statistics to the managements of the railroads, Interstate Commerce Commission and the Labor Board, in securing efficient and economical operation.

2nd: The compiling and reporting of such data in the most economical and simplified way that will meet the requirements.

It has been demonstrated by experience that the present wage statistics do not meet the requirements of a wage adjustment and that it is necessary to prepare specific data to meet proposed changes in working rules and rates of pay as they may arise. The proposed modification does not solve this phase of the subject.

Many of the larger systems have indicated that the wage statistics as now prepared and submitted monthly to the Interstate Commerce Commission are of little, if any, use or benefit to the railway managements.

Inasmuch as the present classification and the monthly reports of employees and their compensation were devised and put into effect by the Interstate Commerce Commission and the United States Railroad Labor Board, the problem resolves itself into the extent to which simplification and economy may be realized in producing such wage statistics as will meet the minimum needs of the Commission and the Labor Board. The Railway Accounting Officers Association stands ready to cooperate with you in accomplishing this result.

The committee advised that the subject would be continued on the docket of the committee.

Method of Reporting Equipment While in Contract Shops on Monthly Reports of Operating Statistics

The committee expressed its opinion that locomotives and cars sent to contract shops for repairs should be reported on Forms OS-A and OS-B, while in or on route to, or from such shops, should be reported as "on line."

Definition of Branch Lines in Connection with Miles of Road Operated

The committee approved a suggestion by Dr. Lorenz, director of the I. C. C. Bureau of Statistics, giving a definition relating to branch lines and reading as follows: "Lines serving one or more stations beyond the point of junction with the main line or another branch line and to or from which stations, train service, or its equivalent is performed."

on Freight Accounts

Moran, auditor freight accounts of the Erie. Mr. Moran pointed out the ideas which had been followed by the committee with reference to the revision of the forms. He said that it is the desire to improve the forms whenever that course is advisable but that the committee had thought it best to proceed carefully because the carriers had the forms printed in large quantities and it was not thought advisable to change the forms except for a very good reason.

Standard Form of Waybill to Be Used By Packers Covering Peddler Car Traffic

The committee presented several standard forms and methods "which can be adopted at all packing centers with such modifications as are necessary to meet local conditions." The results of the study made of this problem were explained to the association by Paul Peters, auditor freight traffic of the Rock Island.

Waybilling Shipments Accorded Transit Privileges

The committee recommended that the following be inserted in the R. A. O. A. procedure:

In view of the fact that conditions of transit tariffs vary with commodities and different sections of the country, no one plan can be universally followed. Shipments accorded transit privileges should, therefore, be waybilled by the carriers granting transit privileges in accordance with their tariff publications and accounting practices, and waybill destination carriers shall apportion or adjust, as necessary, revenue due interested carriers from point at which the privilege is granted to destination through interline freight accounts.

The committee further recommended that the Traffic Associations be notified by the secretary that in view of the fact that conditions of transit tariffs vary with commodities and different sections of the country no one plan can be universally followed, and request them to endeavor to promote uniformity in traffic regulations covering transit privileges, and the committee further recommended that this subject be referred to the incoming freight committee. Explanation of this subject was presented by H. B. Ochiltree, auditor freight accounts, Union Pacific, whose remarks were ordered to be printed for distribution to the membership.

Recapitulating Correction Accounts

The committee suggested certain changes with relation to this subject, among which was a new form, No. 114, to be used in place of mandatory Form No. 113. S. L. Porter, auditor freight accounts, C. B. & Q., explained the committee's action and discussed the general subject of changes in the mandatory rules and the mandatory forms. The most important point which he made was that it was desirable to keep the changes in either rules or forms at a minimum.

Revision of Waybill Forms

The committee reported as follows:

A number of suggestions have been made for revising the existing waybill forms, and your Committee feels that those suggestions should be considered by the Freight Committee next year, in order that the Committee may determine whether it feels that any of those suggestions are such as to warrant revision of the forms.

Your Committee is of the opinion that if and when any revision is made in the waybill form, the Freight Committee should specifically call the attention of the Association to the changes made, and the Committee should give, in detail, its reasons for making those changes in the form.

A revision of the form of waybill, in itself, is no goal to be sought after, until and unless the revision is founded on conditions of such general and practical application as to be warranted.

The following report, submitted by your Committee, would apply, regardless of whether the Freight Committee does or does not undertake to make any revision in the waybill forms, the report being a statement of general principles, prepared more particularly for the information of those accounting officers who are not members of the Freight Committee, and, therefore, may not be familiar with this entire situation:

The waybill is the fundamental freight accounting form, and is, therefore, of outstanding significance from a revenue accounting viewpoint.

Every interline waybill is prepared, from an accounting standpoint, primarily for the use of some other road, and not for the convenience or use of the carrier that makes or prints the waybill. This is phase of the matter that should be constantly borne in mind in any contemplated revision of the waybill.

Considering the many interline waybills regularly received in a large railroad accounting office, no argument is needed to demonstrate the necessity for absolute uniformity in size and arrangement of the waybill form. Standardization of the waybill is synonymous with simplification. The saving of clerical work through standardization of the waybill will be clear, to say nothing of the economy in printing usually attained by the use of standardized forms.

In the interest of economy and efficiency, it is of paramount importance that all interline waybills be absolutely uniform in size and arrangement.

Frequently, suggestions for revision of the waybill form are based upon the fact that certain specific waybills have been received mutilated, marked-up or illegible. A larger waybill form or a revised waybill form cannot, in itself, remedy such trouble and cannot prevent employees from mutilating or marking-up waybills or placing stamps so as to make the waybill illegible. The remedy for such a situation lies in the direction of seeing to it that

employees comply with instructions regarding the correct use of the form. As to a large waybill form, the forms are now either 8½ x 11, or 8½ x 20 inches, which should prove ample for all practical purposes.

It is obvious that any blank for general use will not always conform to individual views and may not invariably be adapted to specific cases; but these exceptional conditions are usually such as to be readily sacrificed by the particular carriers, and, therefore, need hardly be of serious concern.

The waybill form has been the subject of consideration for many years, although recently the form has been changed practically every year. This is confusing to the large number of employees who handle the waybill form, and results in inconvenience and difficulties in other directions.

The disposition to frequently revise the waybill may or may not be a favorable indication, but certainly constant change does not necessarily mean progress or improvement. The existing waybill blank is not fixed or unalterable for all time, and not even, perhaps, for the near future; experience may and undoubtedly will show alterations that should be made. Your Committee welcomes constructive suggestions, and will continue to act on such suggestions with the primary consideration of doing what is for the best interests of the railway industry as a whole, but surely at least one year may pass without bringing some revision of the waybill blank.

The present waybill form being the result of much study and consideration, and being devised with the aid and co-operation of the various departments interested, your Committee is of the opinion that the waybill form should be stabilized and should be given reasonable trial before any revision is made, unless some controlling and impelling reason, of general application, is advanced to justify such revision.

Further explanation of the above was made by W. B. Kraft, auditor of revenues, Pennsylvania Railroad.

Dimensions of Stamps Used by Junction Agents and Others on Interline Waybills

The committee advised that it had given a great deal of thought and study to illegible waybilling and found that, in the majority of cases, the illegible billing was chargeable to the indiscriminate use of rubber stamps placed on the face of waybills. It reported, also, that it had found some carriers are using rubber stamps of a size out of all proportion to the size of a waybill, thereby covering important information on the face of the waybills. It offered suggestions as to the form and size of these rubber stamps, suggesting a *junction stamp* not to exceed 1 in. by 1½ in. in size, a *transfer stamp* not to exceed 1 in. by 1½ in., and a *yard stamp*, circular in form, not to exceed 1¼ in. by 1½ in. in diameter. The committee suggested that the stamps thus described should be immediately put into use and all stamps larger than the dimensions shown should be destroyed. It further suggested that:

All other stamps should be confined to the smallest size possible, in order to prevent obliteration of important information on the waybill.

Any other necessary stamps should be placed on the waybill so as not to obliterate charges shown in the money columns.

Your Committee is of the opinion that the standardization of stamps used in connection with interline billing and the careful watching of the application of these stamps by agents, in the designated space on waybills, will go a great way towards eliminating illegible billing.

Accounting officers are, therefore, requested to issue instructions to their agents accordingly.

P. L. Overman, auditor of traffic, Western Maryland, in discussing this subject further for the committee, pointed out that the matter had been brought to the attention of the accounting officers by the Freight Claim and Station Service Sections of the A. R. A., and he further pointed out that these sections had complained particularly about the difficulties resulting from the use of large stamps, illegible writing and the impression of stamps over the important matter, etc.

Interline Accounting

The committee presented three plans dealing with this subject and intended to be an attempt to explain the detailed methods of handling the interior office work relating to interline accounting. The idea behind the adoption of the plans was explained by F. W. Pope, auditor freight accounts of the Southern Pacific, who pointed out that just as interline accounting is a most important feature in accounting work, so is the internal method of interline accounting of leading importance in the work of the accounting department. The committee report in presenting the plans read in part as follows:

Your committee realizes that the writing up of any specific plan involved difficulties because so many different carriers have developed different methods of handling their interline accounts, each of which presumably has advantages and is working satisfactorily. At the same time, it was realized that the

general underlying principles of interline accounting are similar in practically all cases. Differences in method, therefore, are usually differences in detail plans only, such plans having been worked out to meet individual requirements, dependent on conditions governing various audit offices, as, for instance, the volume of interline work, calculating or tabulating machine equipment, etc.

Your committee has, therefore, decided that it is better to present, for your consideration, a plan written up in considerable detail and suitable for requirements of any road having a sufficient volume of interline business to render the use of tabulating machines and other mechanical equipment economical, following the operations through from the reporting of waybills by the agent to the final rendition of interline abstracts and balancing of all the accounts, supplementing this with briefer outlines of two other plans—one, embracing the so-called "proof sheet" method, and the other a method involving the use of no equipment excepting non-listing calculators, only such parts of these plans being written up as differ materially in their general application from the first plan.

Several governing principles have been adopted as being in line with what is now accepted by our Association as good accounting, the principal ones being as follows:

1. Daily basis of agency reporting, including the prompt reporting by agents of all waybills as they are received.
2. Inclusion in the interline freight reports of current month of all waybills thus reported during that month.
3. Settlement in interline account of all waybills on basis of correct figures, that is to say, waybill figures arrived at after the final revision of waybills has been made by the Audit office.
4. Making of a complete balance between agents' accounts and interline accounts before the latter are rendered and complete checking, etc., or suspense items.

Our report also includes an outline of everything that is necessary in connection with the checking, balancing and handling of interline forwarded and interline intermediate accounts.

As the handling of correction accounts is the subject of a separate report under another subject, we have, so far as practicable, eliminated all reference to correction accounts from this report. In places where reference to correction accounts is made, this is because the particular feature could not be intelligently outlined otherwise.

In the report herewith submitted, reference is made to accept R. A. O. A. standard forms, which may be used and copies of other suitable forms are attached, the latter forms having been assigned R. A. O. A. numbers merely for the purpose of facilitating reference.

Definitions of Railway Accounting Terms

The committee advised that it would submit a report regarding this subject at some later time.

Report of the Committee on Passenger Accounts

This committee reported on 38 subjects. The chairman of the committee was L. D. Lacy, auditor passenger traffic, C. & O.

Hat Checks for Use on Trains

The committee realizing the protection that is afforded by the proper use of hat checks gave this matter considerable study and reached the conclusion that hat checks should be issued to all coach passengers destined beyond the next stop of a train. As a matter of information, diagrams of some of the hat checks now in use were submitted, containing practically all features in vogue, which, in some instances, are combined with color schemes; also, with or without the name or monogram of the carrier.

Multi-Route Tickets

The committee recommended the adoption of the following resolution:

WHEREAS, The American Association of Passenger Traffic Officers, at its meeting held in Louisville, Kentucky, October 11, 1922, adopted the report of the standing committee on Standard Forms of Interline Tickets to the effect that where multi-road or multi-route tickets are used, they be confined so far as practicable to multi-route forms, and that use of multi-route forms be restricted as far as possible, and with further recommendation that where

found practicable, the use of multi-road, multi-junction forms be entirely discontinued; therefore, be it

Resolved, That it is the sense of this Association that we fully endorse action taken, and that we co-operate with the American Association of Passenger Traffic Officers to the fullest possible extent, and urge all accounting officers to confer with their passenger traffic officer with a view to having their forms of multi-route tickets printed to conform with the forms recommended for universal use, and also, with a view to having withdrawn the multi-route, multi-junction forms, the objections to use of these particular forms greatly outweighing their advantages.

Conductors Accounting Forms and Practices

The committee presented forms and methods relating to the record of the conductors' performance in the matter of passengers and revenue for each passenger carrying train.

Accounting for Interchangeable Scrip Books Issued and Tickets Issued in Exchange Therefor

The committee submitted recommendations covering accounting features in connection with the use of the interchangeable scrip book prescribed by the Interstate Commerce Commission a short time ago.

Other matters covered by the passenger committee included recommendations as to accounting for excess baggage collections, dining car receipts, etc.

Report of Committee on Disbursement Accounts

This committee, headed by G. H. Pryor, auditor disbursements, B. & O., presented as its first subject a suggested uniform system of records for recording depreciation on equipment, as well as four standard forms in use in connection with this purpose. Among the other important matters discussed by the committee was the subject of fuel accounting and payroll accounting in connection with which

the committee advised that it was studying the subject through a sub-committee and it would report on it later. Another subject of outstanding importance was that headed, "Establishing a Proper Basis for Comparing Material Balances on the Various Lines." The committee advised that it was studying the subject through a sub-committee which would report later and J. F. Dartt, auditor of disbursements of

the Illinois Central, outlined some of the discussion which had taken place with representatives of A. R. A. Division VI, Purchases and Stores. He expressed the view that a comparison of this kind had certain limitations because a rich road would presumably have larger supplies on hand than a small road and he expressed the view that the General Storekeepers classification is the best one and should be adopted.

Uniformity in Arrangement of Items of Expense

The committee suggested a uniform arrangement in the items of expense in the bills rendered on standard bill form R. A. O. A. No. 206.

Election of Officers

The association elected as its officers for the coming year, president, A. J. County, vice-president of the Pennsylvania System; first vice-president, E. M. Thomas, comptroller of the Chesapeake & Ohio; second vice-president, W. C. Wishart, comptroller of the New York Central, and E. R. Woodson, secretary. The following were elected members of the executive committee: L. C. Scott, vice-president of the Wabash; G. E. Bissonnet, general auditor of the Union Pacific; G. J. Bunting, comptroller of the Illinois Central; W. C. Garrick, general auditor of the Richmond, Fredericksburg & Potomac. San Francisco was chosen by a large vote as the place for the 1924 annual meeting.

Safety Rules for Highway Crossings

BY WAY OF GIVING a good start to the Careful Crossing Campaign for 1923, H. E. McGee, general manager of the Missouri-Kansas-Texas has issued a circular, especially for enginemen but containing notes also for other classes, rehearsing the rules by which enginemen are to be guided at crossings and citing some lessons from the experience of 1922. The rules are substantially as follows:

A—Sound the whistle for all public street or road crossings at a distance of not less than 80 rods. Where persons, vehicles or stock are on, near or approaching the track, whistle must be sounded immediately.

B—Two long and two short blasts of whistle must be sounded the second time when vehicle of any description, particularly automobile, is seen approaching the crossing. Further blasts of whistle should be sounded and all other precautions taken to prevent accident.

C—Where view is obscured so enginemen cannot see vehicles approaching, the blasts must be made to extend until engine reaches crossing.

D—Locomotive bell must ring from a point 80 rods from the crossing until engine has passed over crossing, and must ring where persons are on or near track, or where engine is passing cars, buildings, bridges, etc., where persons are likely to step out upon track.

E—On engines equipped with emergency whistle on fireman's side (practically all our passenger locomotives) firemen are required to, and must use this whistle while in emergency and to prevent accidents. This does not relieve the engineer of his responsibility and duty in the use of the whistle.

F—In all cases firemen must notify engineer of vehicle approaching from his side of the engine.

Two years ago a campaign was made in the state of Texas to see if it would be possible to go through a month without a casualty. This is declared to have been to a good degree satisfactory, as there was only one accident. Surprise checks were made, to the number of 9,127, and it was found that the whistle was properly blown in 8,590 of these cases, equal to 94 per cent. There are on the M-K-T 3,500 crossings, and enginemen are exhorted to try to make the record this year 100 per cent instead of 94. Surprise checks will also be made this year. Enginemen are reminded that giving adequate warnings at crossings is a serious duty, as evidenced by the fact that the company spends \$5,000 a month for fuel with which to make these whistle blasts. This estimated cost is based on the assumption that the whistle will be blown at 94 per cent of the crossings, at least; that there will be 12 trains a day over each of the 3,290 crossings, and that each whistle signal will continue through a period of about nine seconds.

More than 5,000 placards are now being distributed by the M-K-T, and agents and other representatives of the company who are in touch with the public are called upon to do everything possible to teach the careless driver to be careful.

Freight Car Loading

FREIGHT CAR LOADING for the week ended June 9 totaled 1,013,249 cars thereby again attaining the million mark after the slump due to the Memorial Day holiday in the week ended June 2. The total reached for the week ended June 9, has been exceeded but three times in the record of the car loading figures, namely in the week of May 26, 1923, when loading totaled 1,014,029 cars; in the week ended October 27, 1922, when loading totaled 1,014,480 and in the record week of October 13, 1920 when the figure of 1,018,539 was reached.

REVENUE FREIGHT LOADED

SUMMARY—ALL DISTRICTS, COMPARISON OF TOTALS THIS YEAR, LAST YEAR, TWO YEARS AGO. WEEK ENDED SATURDAY, JUNE 9, 1923

Districts	Year	Grain and grain products	Live stock	Coal	Coke	Forest products	Ore	Mdse. L.C.L.	Miscel- laneous	Total revenue freight loaded		
										1923	1922	1921
Eastern	1923	7,399	2,938	56,852	3,832	6,758	8,475	67,910	98,321	251,885	.....	.....
	1922	8,964	3,087	7,678	1,462	5,785	3,354	70,605	87,654	.....	188,589	194,648
Allegheny	1923	2,492	2,518	60,691	7,601	3,919	14,524	49,331	84,971	226,047	.....	.....
	1922	2,688	2,438	16,724	4,652	3,064	6,966	51,375	72,615	.....	160,522	166,180
Pocahontas	1923	159	136	27,518	501	2,159	208	6,296	4,809	41,786	.....	.....
	1922	217	158	31,002	238	1,441	27	6,465	4,173	.....	43,721	35,083
Northern	1923	3,441	2,290	20,156	1,382	22,811	1,442	37,585	43,505	132,612	.....	.....
	1922	3,317	2,390	25,356	775	19,213	1,195	37,570	39,547	.....	129,363	110,152
Northwestern	1923	9,219	9,523	7,840	934	20,417	47,863	31,019	39,145	165,960	.....	.....
	1922	10,397	8,037	7,329	1,476	16,813	32,043	29,325	37,534	.....	142,954	115,790
Central Western	1923	8,202	12,287	13,950	428	12,567	3,069	35,861	52,247	138,551	.....	.....
	1922	10,589	11,265	4,248	229	7,135	1,293	36,364	47,137	.....	118,260	107,692
Southwestern	1923	3,478	3,091	3,742	126	7,749	511	14,764	22,947	56,408	.....	.....
	1922	3,805	2,178	2,336	141	7,156	617	14,337	22,229	.....	52,799	57,738
Total West. Dists.	1923	20,899	24,841	25,532	1,488	40,733	51,443	81,644	114,339	360,919	.....	.....
	1922	24,791	21,480	13,913	1,846	31,104	33,953	80,026	106,900	.....	314,013	281,220
Total all roads	1923	34,390	32,723	190,149	14,804	76,380	76,092	242,766	345,945	1,013,249	.....	.....
	1922	39,977	29,353	94,673	8,973	60,607	45,495	246,041	310,889	.....	836,208	.....
	1921	40,940	28,971	161,898	4,884	51,029	29,909	216,585	253,067	.....	787,283	.....
Increase compared	1922	.....	3,170	95,476	5,831	15,773	30,597	.....	35,056	177,041	.....	.....
Decrease compared	1922	5,587	.....	.....	.....	.....	.....	3,275	.....	.....	.....	.....
Increase compared	1921	.....	3,752	28,251	9,920	25,351	46,183	26,181	92,878	225,966	.....	.....
Decrease compared	1921	6,550	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June 9	1923	34,390	32,723	190,149	14,804	76,380	76,092	242,766	345,945	1,013,249	836,208	787,283
June 2	1923	32,340	29,399	171,248	14,389	73,637	73,390	216,386	321,252	932,041	739,559	693,903
May 26	1923	25,522	31,777	192,092	15,000	79,339	70,119	243,834	346,346	1,014,029	806,877	795,335
May 19	1923	33,806	31,274	181,599	15,470	77,653	67,057	244,325	340,613	991,797	780,953	770,991
May 12	1923	31,997	29,689	175,158	15,302	74,424	59,619	243,544	344,798	974,531	767,094	751,186

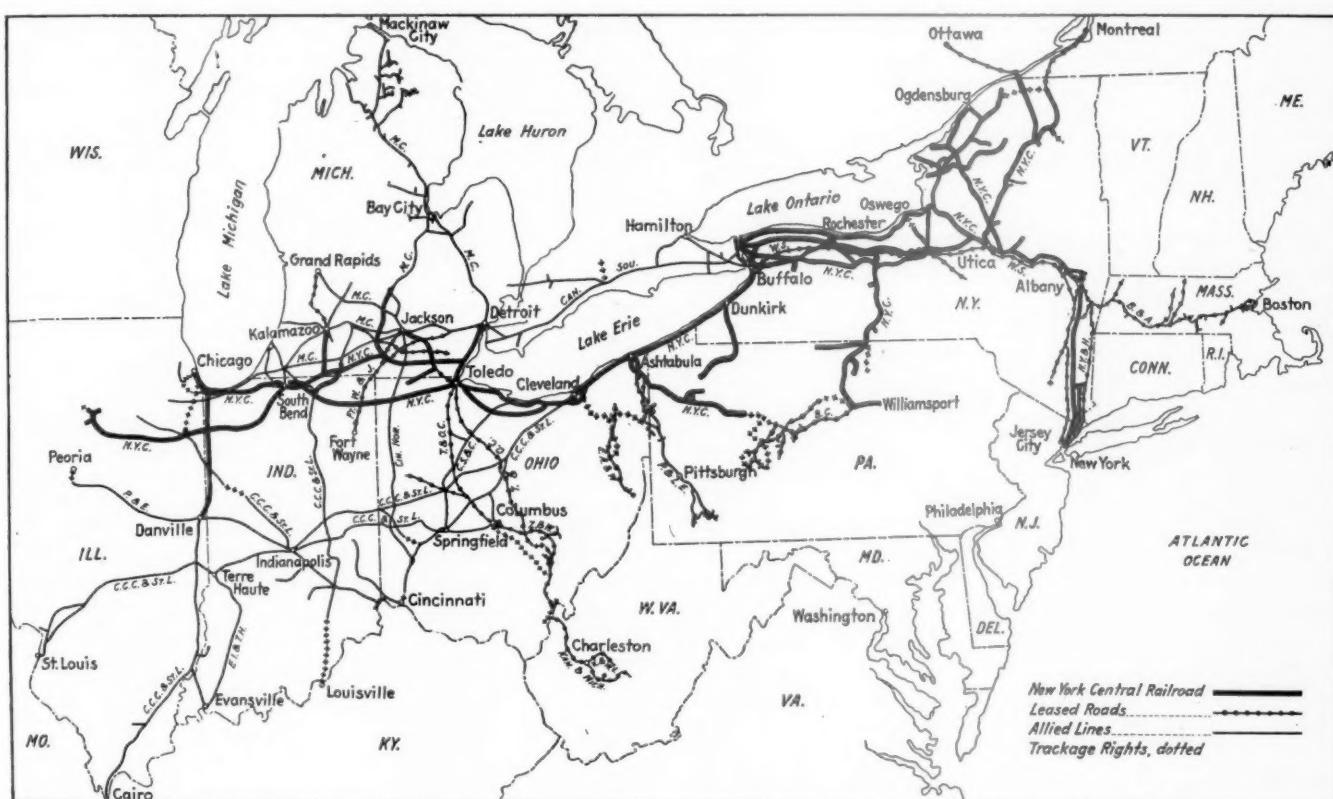
Compiled by Car Service Division, American Railway Association.

New York Central Earnings Justify 7 Per Cent

Parent Company Operations in Latter Months of 1922 Break Records—Realizes on Subsidiaries' Prosperity

TO ANYONE who has followed the operations of the New York Central with any great degree of attention for the past several months, the recent action of the board of directors in raising the dividend rate on the company's stock from 5 to 7 per cent, would come with no surprise. Realizing, of course, that expectancies are not certainties—particularly as concerns changes in dividend rates—what observers were waiting to see was whether the rate would be raised to 6 or 7 per cent. An increase of some kind in the rate has been expected for some time. The directors of the New York Central would hardly have been justified in in-

ket at the present time as is the New York Central. With a rate of 5 per cent, the common stock could not properly sell at par. Indeed, the factor that has kept the quotations even as high as in the nineties for an extended period has been not the yield so much as the continued expectation that the directors would at some time increase the rate to a figure which would make the issue more desirable from the standpoint of railway investors. In the New York Central's case, the particular feature which makes a quotation on the common stock above par desirable is the existence of an issue of \$100,000,000, 6 per cent, debenture bonds issued in 1915



The New York Central System

creasing the rate on the basis alone of what has been shown in the earnings and traffic reports of that period since the end of the coal and railway shopmen's strike. It might be in order to presume, however, that they regarded the rather remarkable operating results which the New York Central has been securing since last September as an indication of the essential strength of the property and as a proof that the several plans which the New York Central has been carrying out over a term of years were justified by the conditions.

In addition to regarding the increase in the dividend rate as a mark of the prosperity of the New York Central System, students of railroad problems will give the increase in the rate attention as an important step in railway finance. The action will presumably be looked upon as a first step taken in an extended period of time to resort to railway financing through the issue of stock instead of bonds. There are but three or four other railroads in the country that are in as favorable position to place railway stock upon the mar-

ket at the present time as is the New York Central. With a rate of 5 per cent, the common stock could not properly sell at par. Indeed, the factor that has kept the quotations even as high as in the nineties for an extended period has been not the yield so much as the continued expectation that the directors would at some time increase the rate to a figure which would make the issue more desirable from the standpoint of railway investors. In the New York Central's case, the particular feature which makes a quotation on the common stock above par desirable is the existence of an issue of \$100,000,000, 6 per cent, debenture bonds issued in 1915

Greater Participation by Stockholders

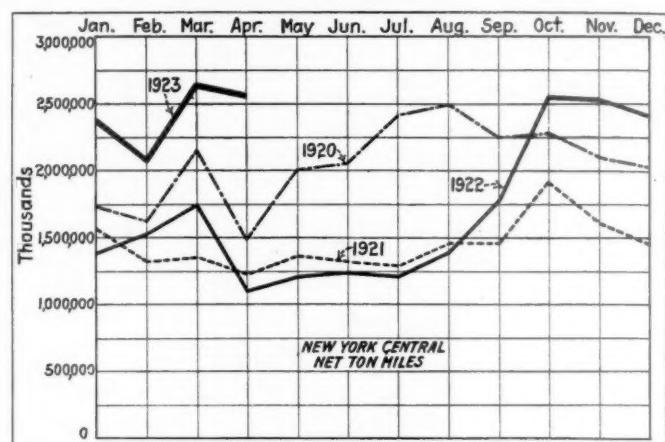
There has been a great deal said in recent years about the economic fallacy of the railroads raising their money through funded indebtedness, rather than through the sale of stock. Over repressive regulation and combined therewith the effects of the war-time demands upon capital emphasized the seriousness of the situation and it has only been comparatively recently that some of the carriers have even essayed to

carry on financing with preferred issues. The gradual improvement in railway affairs which has taken place since the carriers began to indicate progress in overcoming the handicaps foisted upon them by federal control has resulted in interesting discussion of the use of stock in railway financing. A particularly notable contribution has been the raising of the question as to whether it was fair for especially prosperous properties to maintain moderate dividend rates and thereby prevent the stockholders from participating adequately in the favorable net earnings. The New York Central has been given as a case in point and in its case the question was as to whether a 5 per cent dividend rate was fair at a time when the property was earning nearer 10 per cent or even a higher rate. Bearing in mind the desirability of attracting the investor who might be willing to acquire stock and the advisability of financing with stock rather than funded indebtedness, it seems that the suggestion for greater stockholder participation is a good one and the point well taken.

The New York Central made public on Thursday of this week its annual report for the year ended June 30, 1922. This makes the report available at a rather opportune time. Under the conditions, it is quite natural that one of the first things that one should do with the report in front of him is to see the relationship between the New York Central's net income and its dividend requirement. In 1922, the New York Central had available for dividends \$20,635,186. The

earned over the dividends which will be paid in 1923 will be a wide one.

It has usually been considered a fault of New York Central that its outstanding bonds were out of proportion to its stock, although some observers think so well of New York Central as to say that the difficulty is rather that the amount of stock outstanding is too small. The showing which the New York Central has been making in recent years both in its own operations and in the markedly successful operations of its subsidiaries, notably the Big Four and Michigan Central, give much point to the latter contention. As of December 31, 1922, the New York Central capital stock totaled \$267,981,915, an increase over the figure at the end of 1921 of



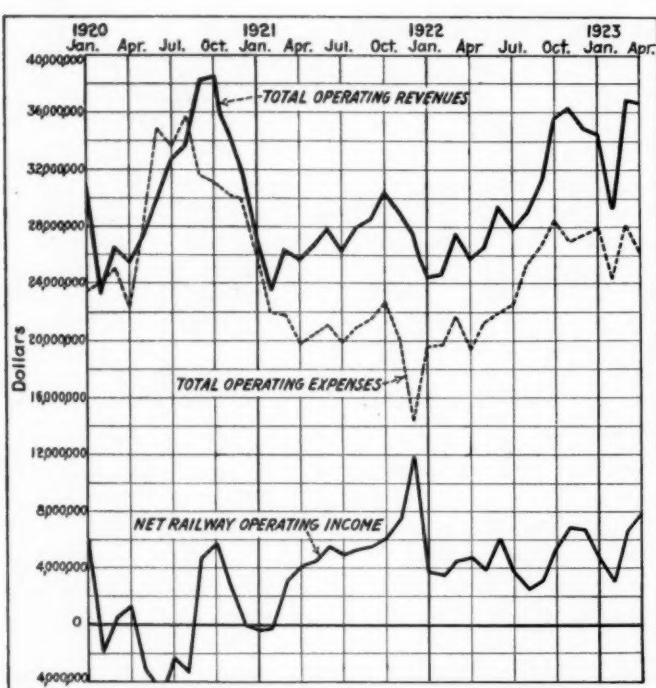
Ohio Central Lines Included Beginning in October, 1922

The Trend of New York Central Traffic

\$18,384,560, this increase being due primarily to the exchange of stock with the Big Four in connection with the merger plan. Long term debt at the close of the year totaled \$672,956,287, an increase over 1921 of \$23,363,318. The present proposal to further the conversion of the 6 per cent debenture bonds into capital stock will change the trend which the New York Central has developed in recent years of doing all its financing through bonded indebtedness and marks, one hopes, the final step in the return to normal conditions in railway financing.

Consistent Earning Power

The New York Central has shown consistent earning power over a long period of years. It showed good net income during the period of federal control and earned for the government a very fair proportion of its standard return. In 1920 it did not do well and earned only a small share of its guaranty for the guaranty period from March to August of that year. The year 1921, however, was one of sharp recovery, due to the excellent manner in which hold was taken of operating expenses and operations generally. The favorable results of 1921 were carried on into 1922. The 1922 final result was, in its last analysis, an average of very adverse and very favorable conditions. The adverse conditions were those that existed during the coal and shopmen's strike, both of which affected the New York Central very adversely, and the favorable conditions were those that existed after the end of these strikes, when the New York Central showed a marked and rather exceptional recovery. This point is worth following out and in doing so, it may be pointed out that the recovery in the latter months of the year was sufficient so that the October net ton-miles were more than double those reported in April, May, June or July, that they were only slightly less than double the net ton-miles of January or August and handsomely in excess of the figures for February and March, when traffic was expanded by the



Figures include Boston & Albany and since October, 1922, Ohio Central Lines. Sharp reduction in expenses shown in December, 1921 due to credit resulting from elimination of maintenance equalization reserves.

New York Central Gross and Net Earnings

5 per cent dividends totaled \$12,876,985 and left a surplus for the year, after the payment of dividends and provision for sinking funds, of \$7,643,871. If the 7 per cent rate had applied in 1922, the dividend payments would have totaled slightly over \$18,000,000 and there would have been left a surplus of approximately \$2,500,000. The year 1922 was, of course, not a typical year, because of the coal and shopmen's strike. The 1923 earnings have thus far run almost 50 per cent above those up to this time last year, and it is a natural expectation that with our present business prosperity and the unusually favorable manner in which the New York Central itself is realizing on this prosperity, that the margin

coal moving in anticipation of the shopmen's strike. Further than that, the recovery in the latter months of the year was sufficient so that all previous traffic records were broken. The best month that the New York Central had reported prior to 1922 was October, 1920. The net ton-miles for that month were exceeded in October, 1923, and again in November, and further than that, the October and November, 1922, figures have since been exceeded in March and April of the present year. The March, 1923, traffic broke all records in the company's history. The New York Central figures of net ton-miles have included the Ohio Central Lines since October, 1922. The comparisons which are made in the foregoing are made with due cognizance of that fact.

It happens that the income statement in the New York Central annual report for 1922 does not show as good net as was shown in the preceding year. On closer analysis, however, it develops that proper comparison as between the two years is vitiated to some extent by the fact that the 1921 net was expanded by adjustments from the federal control or guaranty periods. With these eliminated the comparison as between 1922 and 1921 makes the 1922 figures appear much more favorable. The 1921 report showed the remarkable recovery in the New York Central's efficiency of operation, as compared with 1920. There is no question that this favorable situation was carried on into 1922 and, on the whole, it appears that as an average of the adverse conditions which the New York Central met during the period of the coal and shopmen's strike and, on the other hand, of the conditions during the period of recovery, the 1922 report

crease in transportation expenses was due principally to the increase in traffic and, to a lesser extent, to increases in the cost of fuel due to the coal strike. There was, however, a reduction of \$3,000,000, or 40 per cent, in loss and damage to freight. The increase in maintenance of equipment expenses was sufficiently large as to make up by far the greater part of the total increase in operating expenses. The annual report assigns as the reason for this: Extraordinary freight car repairs by which bad order cars were reduced approximately 50 per cent during the year; to extensive work on passenger equipment necessitated by reason of repairs having been deferred in previous years; to increased locomotive repairs due to work deferred in 1921 on account of depression, when shops were closed for a protracted period and to increased costs incident to the shopmen's strike. The New York Central has been reporting for some time a high percentage of bad order cars and of locomotives held for repairs requiring over 24 hrs. In a review of New York Central operations which appeared in the *Railway Age* about a year ago, a statement was made of this fact and it was suggested that while the New York Central was not suffering from any car or locomotive shortage, there would probably have to be large sums of money spent for equipment repairs. This prophecy, or whatever one may desire to call it, has apparently been borne out. The figures show that on July 1, 1922, the New York Central's bad order cars were 17.9 per cent of the total on line. In the eleven months since that time, this percentage has gradually been reduced so that on May 15, 1923, it was 10.1 per cent, representing a condition much improved over

NEW YORK CENTRAL TRAFFIC AND EARNINGS—SELECTED ITEMS, 1914-1922

Year ended Dec. 31	Total mileage	Total operating revenues	Net operating expenses	Gross operating ratio	Net corporate income	Revenue tons	Rev. tons one mile	Av. haul	Earnings per ton per mile (cents)	Av. train load	Av. car load
1914..	5,640	152,351,590	113,348,423	39,003,167	74.40	45,664,933	9,358,248	80,446,739	15,150,313,773	188.33	0.595
1915..	5,640	167,912,333	109,394,345	58,517,989	65.15	66,809,329	27,711,474	87,828,429	17,617,028,312	200.58	0.592
1916..	5,689	201,585,049	129,738,369	71,846,679	64.36	85,967,446	45,659,217	106,407,668	21,382,080,540	200.94	0.598
1917..	5,685	216,267,517	153,597,905	62,669,612	71.02	66,873,026	25,599,220	110,237,661	22,542,547,774	204.49	0.603
1918..	5,682	269,270,957	210,637,849	58,633,108	78.23	*69,270,921	17,917,123	117,495,612	23,851,287,933	202.99	0.737
1919..	5,675	283,659,331	224,964,912	58,694,419	79.31	*71,308,505	19,917,251	96,048,798	20,186,749,942	210.17	0.862
1920..	5,684	338,624,457	317,553,242	21,071,215	93.78	*65,109,739	13,734,688	110,753,433	22,567,928,559	203.76	0.930
1921..	5,704	292,130,995	221,768,390	70,362,605	75.91	75,097,499	22,295,686	74,475,185	14,831,625,456	199.15	1.208
1922..	5,710	316,620,098	250,400,470	66,219,628	79.09	69,951,089	20,635,186	86,077,233	17,648,981,291	205.04	1.122

*Includes standard return and guaranty.

leaves little to be desired. In the New York Central income statement the gross and net earnings from operations include only the mileage operated by the parent New York Central Company, 5,710 miles. The leased Boston & Albany and Ohio Central Lines (Toledo & Ohio Central; Zanesville & Western; Kanawha & Michigan; Kanawha & West Virginia) appear in the statement under separately operated properties, "profit" or "loss," and the net earnings of the other lines in the system appear under dividend income.

The net operating income of the New York Central for 1922 was \$50,571,544, as compared with \$54,938,035 in 1921, a decrease of \$4,366,491. The railway operating revenues for 1922 were \$316,620,098, as compared with \$292,130,995 in 1921, an increase of \$24,489,103. There was an increase of \$28,632,080 in operating expenses, the 1922 figure being \$250,400,470 and that for 1921, \$221,768,390. It happens, however, that in 1920 the New York Central set aside maintenance equalization reserves which in 1921 it eliminated. The 1921 operating expenses, therefore, were reduced to the extent of the credit necessary to take care of this elimination. The reserve charges approximated \$7,000,000, with a result that, as far as a comparison with 1922 is concerned, the 1921 operating expenses figure should, in reality, be increased in that amount. The 1922 operating ratio was 79.09. Exclusive of the credit for equalization reserves, in 1921, the operating ratio was 78.24.

As compared with 1921 there was an increase in transportation expenses approximating \$4,000,000 and in maintenance of equipment approximating \$18,000,000. The in-

crease in transportation expenses was due principally to the increase in traffic and, to a lesser extent, to increases in the cost of fuel due to the coal strike. There was, however, a reduction of \$3,000,000, or 40 per cent, in loss and damage to freight. The increase in maintenance of equipment expenses was sufficiently large as to make up by far the greater part of the total increase in operating expenses. The annual report assigns as the reason for this: Extraordinary freight car repairs by which bad order cars were reduced approximately 50 per cent during the year; to extensive work on passenger equipment necessitated by reason of repairs having been deferred in previous years; to increased locomotive repairs due to work deferred in 1921 on account of depression, when shops were closed for a protracted period and to increased costs incident to the shopmen's strike. The New York Central has been reporting for some time a high percentage of bad order cars and of locomotives held for repairs requiring over 24 hrs. In a review of New York Central operations which appeared in the *Railway Age* about a year ago, a statement was made of this fact and it was suggested that while the New York Central was not suffering from any car or locomotive shortage, there would probably have to be large sums of money spent for equipment repairs. This prophecy, or whatever one may desire to call it, has apparently been borne out. The figures show that on July 1, 1922, the New York Central's bad order cars were 17.9 per cent of the total on line. In the eleven months since that time, this percentage has gradually been reduced so that on May 15, 1923, it was 10.1 per cent, representing a condition much improved over

that of a year ago, but still much above the desired 5 per cent which the A. R. A. program calls for to be reached on October 1.

On July 1, 1922, the New York Central had 27.8 per cent of its locomotives held for repairs requiring over 24 hrs., but at the same time it had a surplus supply of 529 serviceable locomotives stored. On September 15, the percentage had become 37.9 and the number of stored locomotives had been reduced to 40. The New York Central was one of the first roads to settle with the striking shopmen under the Willard-Warfield agreement. There has been some criticism in some quarters of its having settled the strike in that manner, although those who criticize it are confronted with the remarkable results which have been obtained in traffic and earnings since that time. However, to bring the facts up to date as to locomotive condition, it should be noted that the percentage unserviceable on May 15, 1923, had become 20.7 and at that time, the number of locomotives stored serviceable was 234. The number of stored locomotives, while the road is handling its present heavy traffic, is indicative of the amount of equipment which the New York Central has on its lines and shows the results of the large acquisitions of power which it has been making for the past several years.

The most noteworthy feature in New York Central operations just now is the extremely favorable results which it has been reporting for the past several months. For the first four months of 1923 net operating income totaled \$22,172,757, as compared with \$16,394,918 for the first four months of 1922. The operating ratio for the first four months this year was

77.6 and in April the ratio was brought down to 71.6. These figures include the Boston & Albany and the Ohio Central Lines, and are not properly comparable with the complete figures for 1922 given in the earlier part of this article.

Reasons for Traffic Expansion

It would be desirable to seek an explanation for the sharp expansion in the New York Central traffic since last September. Unquestionably, the principal reason is the New York Central's strategic location. It is natural to expect that as one of the two leading trunk line carriers the Central would be about the first road to realize on reviving business prosperity, such as that with which the country was favored in the fall of 1922. Apparently the prompt settlement of the strike must have been an important factor, particularly in view of the fact that the neighbor anthracite carriers saw fit to fight the strikers through with resulting adverse effect on their ability to handle their tonnage adequately. A good index of railway efficiency is the adherence to fast freight schedules. The New York Central was practically the first road to restore its fast freight service to normal after the strike and has been securing rather better performance since than most of its neighbors. A point that should not be forgotten, also, is the wide extent of the New York Central system and the manner in which traffic from all over that section of the country east of Chicago and north of Pittsburgh converges onto New York Central rails. The Big Four and Michigan Central both had prosperous years in 1922, the advantages to the parent company accruing in the form of interchange traffic and in dividends. The Boston & Albany returned a handsome profit. The Ohio Central lines, as it happens, did not. The Big Four common stock now pays 4 per cent dividends. The Michigan Central paid 4 per cent in 1920, 6 per cent in 1921, 8 per cent in 1922 with an extra of 6 per cent (the 6 per cent extra dividend accruing to the parent company, however, in 1923) and has this month been put on a 10 per cent semi-annual basis. The Boston & Albany's profit appears in the income account as "separately operated properties' profit," as has already been noted.

System Operations

The figure that shows the results of the operation of the system as a whole is that of net income available for dividends which in 1922 was \$20,635,186, comparing with \$22,295,686 in 1921, a reduction of \$1,660,500. Analysis of the figures included in the income statement under non-operating income develops the fact that the 1921 total included an item of \$4,281,608, additional compensation and adjustment of standard return, for use of the property during federal control. This, of course, was not in reality a 1921 matter, insofar as operations are concerned, although, of course, it was properly included in the 1921 corporate income. However, consideration of it is necessary in making proper comparisons as between 1921 and 1922. An interesting point in connection with the non-operating income for 1922 is the fact that the dividend income for the year is given as \$10,309,803 as compared with \$6,316,257 in 1921, an increase of not quite \$4,000,000. This is largely the result of the New York Central's increased holdings of the stock of the Big Four and to the increase in the dividends on the Michigan Central stock. The New York Central is gradually carrying out its plan to merge the Big Four with the parent company, it having offered in December, 1921, to exchange Big Four preferred stock par for par with New York Central and the common stock at a rate of five shares of Big Four to four of Central. During the year the parent company acquired 82,352 shares of Big Four preferred and 126,867 shares of common, and at the end of the year it held 82.36 per cent of the Big Four preferred stock, 91.21 per cent of the common, or 89.66 per cent of the total outstanding stock. During 1922, also, the parent company acquired 6,182 shares of

Michigan Central stock, paying therefor \$350 a share, making its holdings in Michigan Central at the end of 1922 174,375 shares, equivalent to 93.06 per cent of the total outstanding Michigan Central stock.

Progress Made on A. R. A. Transportation Program

WASHINGTON, D. C.

THE CAR SERVICE DIVISION of the American Railway Association, has issued a second monthly statement of the progress made on the "Program to Provide Adequate Transportation," as approved by the members' meeting of the American Railway Association and of the Association of Railway Executives on April 5.

Total cars of revenue freight loaded for the 22 weeks to June 2 inclusive show a consistent increase above the estimated figures as well as far in excess of the total for same periods of the previous years for which we have record. Following is the cumulative loading by commodities and total for the first 22 weeks of 1923 compared with the corresponding period of previous years.

	1923	1922	1921	1920
Grain and G. pro.	883,352	940,008	829,567	722,549
Live stock	705,524	627,642	622,491	660,307
Coal	4,047,507	3,051,665	3,249,849	3,907,411
Coke	330,724	179,826	155,430	235,078
Forest products	1,590,451	1,169,603	1,079,305	1,352,981
Ore	536,183	195,651	246,439	546,572
Mdse. L. C. L. and misc.	11,874,072	10,441,841	9,388,703	10,395,989
Total	19,967,813	16,606,236	15,571,784	17,820,887

The new equipment put in service and on order is as follows:

Cars	Put in service January 1 to June 1, 1923	On order June 1, 1923
Box	27,862	45,709
Refrigerator	7,468	13,237
Coal	26,806	43,113
Stock	1,696	1,814
Flat	1,374	2,085
Others	454	1,121
Total	65,660	107,079
Locomotives	1,697	2,041

Other statistics showing progress are given in the report as follows:

ALL FREIGHT CARS AWAITING REPAIRS

	January 1, 1923	June 1, 1923
Heavy	164,041 cars or 7.2 per cent	155,564 cars or 6.9 per cent
Light	51,970 cars or 2.3 per cent	56,202 cars or 2.5 per cent
Total	216,011 cars or 9.5 per cent	211,766 cars or 9.4 per cent

STEAM LOCOMOTIVES AWAITING REPAIRS

	January 1, 1923	June 1, 1923
Heavy	13,587 loco. or 21.1 per cent	11,368 loco. or 17.8 per cent
Light	1,962 loco. or 3.0 per cent	1,315 loco. or 2.1 per cent
Total	15,549 loco. or 24.1 per cent	12,683 loco. or 19.9 per cent

RAILROAD FUEL STOCKS

	January 1, 1923	June 1, 1923
Tons in cars	2,443,460	2,554,307
In stock piles	4,313,426	5,880,373
Total	6,756,886	8,434,680

	Tons per car	Miles per car per day	
1923	1922	1921	
January	29.0	27.6	30.1
February	28.2	28.3	28.4
March	27.9	27.7	27.2
April	27.8	24.4	26.9
1923	1922	1921	
25.8	20.4	23.2	
24.8	23.2	21.3	
27.0	24.4	20.9	
27.9	21.3	20.6	

CROSS CROSSINGS CAUTIOUSLY.—Educate the automobile driver to a sense of responsibility. That is your task. There is at present a state of mind to be corrected. It is our duty to humanity and to loved ones and friends to impress on every auto driver a sense of responsibility. If you are the occupant of a car, demand that the driver stop and look both ways before crossing a railroad. Such action on *your* part will do more than all the laws and warning devices for the prevention of grade crossing casualties.—B. R. & P. Circular.

Supreme Court Again Discusses Valuation Methods

WASHINGTON, D. C.

THE ATTITUDE of the Supreme Court of the United States as to methods of making valuations of public utilities was given a further interpretation, although in the opinion of one of the justices it was further confused in two decisions handed down on June 11, both of which discuss the recent decision in the Southwestern Bell Telephone case. Whereas in that case the court condemned a valuation made by the Missouri public service commission because the commission failed to take into consideration or give any weight to present costs of labor, materials and supplies, in spite of the large increase over those of the date of valuation, the court has now sustained a valuation of the property of a gas company made by the Georgia railroad commission on the ground that it gave careful consideration to the reproduction cost as of valuation date, although it allowed other evidence to outweigh that evidence and declared that present fair value is not synonymous with present replacement cost, particularly under abnormal conditions. In other words, while the court holds that reproduction cost as of the date when rates are being fixed on the basis of a valuation is one of the factors to be considered under the rule of *Smyth vs. Ames*, it is not a controlling factor nor the measure of value. Another decision rendered on the same day, the opinion being by Justice Butler, who was until recently engaged as counsel for the railroads in valuation cases, condemns a valuation based on actual cost and holds that in the case involved 6 per cent is below a fair return.

In the case of the Georgia Railway & Power Company, *et al.*, appellants, vs. Railroad Commission of Georgia *et al.*, there was involved a valuation for rate-making purposes of the property of a gas company in which the commission found the value to be \$5,250,000 while the company claimed it was at least \$9,500,000. In this case the opinion of the Supreme Court sustaining the valuation was by Justice Brandeis, who had written a vigorous dissenting opinion in the telephone valuation case. This case is unlike the telephone case, Justice Brandeis said, because "Here the commission gave careful consideration to the cost of reproduction but it refused to adopt reproduction cost as the measure of value. It declared that the exercise of a reasonable judgment as to the present fair value required some consideration of reproduction costs as well as of original costs, but the 'present fair value' is not synonymous with 'present replacement cost,' particularly under abnormal conditions. That part of the rule which declares the utility entitled to the benefit of increases in the value of property was, however, specifically applied in the allowance of \$125,000 made by the commission to represent the appreciation in the value of the land owned. But it likewise held that there was no rule which required that in valuing the physical property there must be 'slavish adherence to the cost of reproduction less depreciation.' It discussed the fact that since 1914 large sums had been expended annually on the plant; that part of this additional construction had been done at prices higher than those which prevailed at the time of the rate hearing; and it concluded that 'averaging results and remembering that values are matters of opinion no constitutional wrong clearly appears.' The refusal of the commission and of the lower court to hold that, for rate-making purposes, the physical properties of a utility must be valued at the replacement cost less depreciation was clearly correct. The question on which this court divided in the Southwestern Bell Telephone case, *supra*, is not involved here."

Justice McKenna, however, vigorously dissented from this decision, saying that while the Georgia commission had conceded the rule that "the value of the property is to be de-

termined as of the time when the inquiry is made regarding rates" it had violated that rule, "and upon a unique justification." He quotes it as saying: "The human race is only recovering from an experience the like of which the world has never before endured—a world war—a world upheaval—an economic cataclysm. There are no stable measures of value today." Upon this, Justice McKenna says: "The commission departed from the values which then prevailed, and from those that the rule of law prescribed, that is the values prevailing at the time the property was being used for the public, and reverted to the values which obtained January 1, 1914—values that had not existed for over seven years, and no prophecy could say when, if ever, they would exist again. Similar action was condemned in the Bluefield case—no 'economic cataclysm' repelling. May I ask what had become of the cataclysm? Had it settled in Georgia in conscious indulgence to life and business in other parts of the country from its bewildering influence?

"In the Bluefield case the value of the utility at the time of regulation 'appears,' according to the declaration of the court, 'to have been wholly disregarded.' It will be observed the commissions did exactly the same thing, and yet the action of one is affirmed and the action of the other reversed. This contrariety of decision I cannot reconcile."

The Bluefield case, to which Justice McKenna refers, was a unanimous decision of the court written by Justice Butler, involving a valuation of the property of the Bluefield Waterworks & Improvement Company by the West Virginia Public Service Commission. The commission fixed \$460,000 as the amount on which the company is entitled to a return, while the company claimed that the value of the property is greatly in excess of that amount. The court said: "The record clearly shows that the commission in arriving at its final figure did not accord proper, if any, weight to the greatly enhanced costs of construction in 1920 over those prevailing about 1915 and before the war, as established by uncontradicted evidence; and the company's detailed estimated cost of reproduction new, less depreciation, at 1920 prices, appears to have been wholly disregarded. This was erroneous. The final figure, \$460,000 was arrived at substantially on the basis of actual cost less depreciation plus 10 per cent for going value and \$10,000 for working capital. This resulted in a valuation considerably and materially less than would have been reached by a fair and just consideration of all the facts. The valuation cannot be sustained."

Also the decision finds that "under the facts and circumstances indicated by the record, we think that a rate of return of 6 per cent upon the value of the property is substantially too low to constitute just compensation for the use of the property employed to render the service." The return should be reasonably sufficient, the court said, to assure confidence in the financial soundness of the utility and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise the money necessary for the proper discharge of its public duties, and in this case the record showed that the rate of return to the company had been low through a long period up to the time of the inquiry by the commission.

HONORABLE WILLIAM D. UPshaw, member of Congress from the fifth district of Georgia, proposes to introduce a bill in the next Congress, requiring that automobiles shall be brought to a stop before passing over railroad grade crossings. Mr. Upshaw has taken this action at the request of a committee of locomotive engineers. Representatives of this committee, supporting their request, declare that the automobile hazard at crossings is constantly growing worse. On the Atlanta & West Point, an engineman expects to see a number of narrow escapes every day; and on the lines of that road, they say, that from 1 to 15 automobiles probably are struck by trains every week.

Superintendents Discuss Many Operating Problems

Numerous Topics Considered by Transportation Officers at Annual Convention at Kansas City

MORE THAN ONE HUNDRED general superintendents, division superintendents and trainmasters, met at Kansas City, Mo., on June 13-15, on the occasion of the thirtieth annual convention of the American Association of Railroad Superintendents. This was the first meeting which this association has held since 1916, the war and labor troubles having made it impracticable for operating officers to leave their territories in any numbers in this interval. Many problems coming before the association have, however, been handled by the executive committee, which has met at regular intervals throughout the period since the last convention. An interesting feature of the meeting was the presence of four representatives of the National Railways of Mexico, who were sent by their government as delegates from the Mexican Association of Railroad Superintendents, which was organized in October, 1922.

The officers elected at the 1916 convention, who have

with an appeal for railway officers to gain that vision of their work that they will recognize in it not only the running of a railroad, but the rendering of a service essential to the welfare of more than a hundred million people.

In speaking in behalf of the Kansas City Railroad Superintendents' Association, G. O. Brophy (U. P.) also referred to the important opportunity which the members of this association have to mould the opinion of their employees on railway matters by bringing the facts to their attention.

Report of the President

The American Association of Railroad Superintendents was organized in 1911 with 12 members as a continuation of the Central Association of Railroad Officers, which had no individual membership but whose membership was composed of railroad companies at important terminal points. With the advent of federal control of the railroads it was necessary



At the Live Stock Exchange, Kansas City,

served through the convention of last week, were: President, W. S. Williams, general superintendent, Western lines, Illinois Central, Waterloo, Ia.; first vice-president, C. E. Rickey, terminal superintendent, Southern, Cincinnati, Ohio; second vice-president, A. G. Smart, general superintendent, Chicago, Burlington & Quincy, Alliance, Neb.; secretary-treasurer, J. Rothschild, Terminal Railroad Association of St. Louis, St. Louis, Mo.; chairman executive committee, Charles Burlingame, superintendent, Terminal Railroad Association of St. Louis, St. Louis, Mo.

In welcoming the association to Kansas City, John B. Pew, city counsellor of Kansas City, emphasized the necessity for public authorities to consider the problems of the carriers as well as the people and to temper their demands to the measure of the roads to pay. He advocated the opportunity for the freest display of individual initiative consistent with proper protection of the public interest, and closed with an appeal to the superintendents to cultivate in their men a love for their job.

J. F. Holden, vice-president of the Kansas City Southern, also addressed the opening session, emphasizing the place of transportation in our modern industrial life. He referred to the division superintendent as no longer a director of men but a leader of them. He placed the responsibility for the killing of the agitation for government ownership on the operating officers, for if they render the service the public demands, the people will let well enough alone. He closed

for these local divisions to shift for themselves, since which time this association has continued as one composed entirely of individual members representing more than 300 railroads.

In spite of the obstacles which have prevented the holding of annual meetings, the membership increased from 740 in 1916 to 1,168 at the present time, an increase of 428 members or 58 per cent. The financial condition of the association is equally encouraging, there being on hand on May 31 \$5,329, the larger part of which is invested in good railroad bonds.

Never in the history of transportation was there a time when an organization like ours had a greater opportunity to perform a real service. It has been said that the railroads of the country are on trial and that their destiny depends largely upon their operating records for the present year. In my opinion, no group of railroad men are in better position to make that record one which will vindicate the railroad executives and managers than the members of this association. I, therefore, urge that this association, as a unit, and each member as an individual transportation officer actively engage in carrying out the program adopted by the American Railway Association to insure adequate transportation service during 1923.

I also feel that our association should take an active interest and part in promoting better relations between the railroads and the public. A strong effort is being made by a number of radicals to mislead and misguide the public

with reference to issues surrounding the railroad problem. In prosecuting their campaign of misrepresentation against the railroads, a number of radical politicians have been laying great stress upon the alleged excessiveness of the tentative valuation placed upon railway properties for rate-making purposes by the Interstate Commerce Commission. Apparently they are endeavoring to create the impression that freight and passenger rates could be materially lowered if the tentative valuation were reduced and the railroads permitted to realize a fair return upon the reduced valuation.

A reduction in the tentative valuation could not, in itself, have any effect upon operating expenses, taxes and rents for the use of equipment and joint facilities. It would not, therefore, affect the expenditure of 86 cents out of the average dollar taken in by the railroads in 1922. Its only effect would be upon the net operating income. Obviously, a reduction in the tentative valuation (regardless of the established unfairness of such a reduction), since it would affect disposition of only 14 cents of each dollar received by the railroads in compensation for services performed, would not make possible any extensive reduction in freight and passenger rates. The small effect upon freight and passenger rates of a revision, either upward or downward, of the tentative valuation is illustrated by the fact that to have earned a fair and reasonable return in 1922 (that is, 5.75 per cent

not expected and comparatively few accidents occur at the crossings considered the most dangerous. That, of course, is because automobilists use more care for their own safety at the dangerous crossings. Experienced railway men who have made a study of the subject also claim that a bad accident in a community in which lives are lost or people are seriously injured is invariably the signal for a great hue and cry in that community for the elimination of the crossing where the accident occurred, or the protection of it by gates or electric warning bell or a crossing watchman.

Crossing gates do not entirely eliminate accidents for the reason that people become educated to rely upon the gates instead of upon their own faculties. If the man in charge of the gates errs, or if the gates get out of order, the danger of accident is great. Electric warning bells do not entirely eliminate accidents. If they ring a great deal automobilists disregard them. In addition to that, there is always the possibility that the bell may not be in order at the moment of greatest danger. Crossing flagmen are not infallible. The human element enters into most accidents in one way or another and crossing flagmen are like other human beings. Some of the very worst automobile accidents that have occurred have been at crossings where flagmen were on duty.

One of the effects of so-called crossing protection is to



Studying the Handling of Live Stock

on the tentative valuation), the railroads would have had to increase the average revenue received for each ton of freight carried one mile by less than two-thirds of one mill and the average revenue received for each passenger carried one mile by slightly less than one and two-thirds mills. The costs of performing transportation service have to be met in some way unless the railroads of the country are to be wrecked by inadequate earnings and surely the 4.14 per cent which they earned last year cannot be considered as excessive, or even adequate. How many business men in other lines of business would be satisfied with this return from their annual operations? It is time that every one of us, together with our subordinate officers and employees, take an active part in assisting our executive officers in stamping out this dastardly campaign of misrepresentation and in educating the public at large as to the true railroad situation.

Another subject which I think should be given careful consideration by our association is the prevention of grade crossing accidents. For the six year period ending December 31, 1922, there were 21,902 automobile grade crossing accidents reported to the Interstate Commerce Commission, in which 9,849 persons were killed and 27,349 injured.

Experienced railway men who have made a study of the subject claim that automobile grade crossing accident statistics prove that the crossings considered the most dangerous are actually the safest. In other words, the majority of the accidents occur at the outlying crossings where trains are

teach the public that the crossings are safe, when as a matter of fact the opposite should be taught. It is clear that the policy of the past of trying to place the responsibility for safety at railway grade crossings upon the railways has not accomplished the desired results. It has not prevented automobile grade crossing accidents. There is no definite way of telling whether it has even tended to reduce them.

The grade crossing problem is usually considered from two viewpoints—that of the railways on the one side and that of the public on the other side. There is also the viewpoint of engineers and firemen, which has been almost entirely overlooked. At best their duties are nerve-racking and the habit of automobilists in racing to crossings and darting upon the track immediately in front of the locomotives has a great tendency to shatter the nerves of these men. They ought to have some assurance that an automobile will be brought to a stop before it is permitted to cross a railway track.

Reduction in the number of grade crossings by the relocation of highways should be considered wherever practicable. In plans for new highways, railway crossings should be avoided as much as possible. That this has not been done in the past is evidenced by the fact that the new hard road trails seems to have been laid out and constructed without much thought as to railroad grade crossings.

The following recommendations are submitted for your consideration and discussion: (1) The adoption of a pro-

gram for the gradual elimination of grade crossings, the expenses to be borne by the taxpayers and the railways in proportion to the benefits received—this program to become effective immediately following the necessary enlargement of terminals, improvement of roadways and acquisition of sufficient equipment on the part of the railways to enable them to take care of the traffic demands; (2) relocation of highways where by so doing it may be possible to reduce the number of grade crossings; (3) avoid the crossing of railways as much as possible in plans for new highways; (4) require the railways to install and maintain proper warning signs at railway grade crossings; (5) require railway property at grade crossings to be kept as free as possible from obstruction to the vision; (6) require counties to remove all obstructions to the view, such as trees, underbrush and unnecessary buildings, and other obstructions located on private property near railway grade crossings; (7) the passage and enforcement by municipalities and the states of proper "Stop, Look and Listen Laws"; (8) teach everybody, commencing with the children in the schools, that railway grade crossings are extremely dangerous—the "protected" as well as the unprotected crossings; (9) educate the public in regard to the inability of the railways to eliminate all grade crossings and the unfairness of some communities insisting upon the railways doing things for them that cannot be done for all; (10) launch a great crusade having the backing of the state government against careless driving of automobiles, particularly at railway grade crossings.

Superintendents' Contact with Public Stressed

The annual dinner, which was held on Wednesday evening, was addressed by W. G. Bierd, president, Chicago & Alton; Samuel O. Dunn, editor, *Railway Age*, and W. J. Bailey, governor, Federal Reserve Bank, Kansas City, Mo. Mr. Bierd chose as his subject "The Needs of the American Railroads and the Public Served by Them," while Mr. Dunn spoke on the topic "Can the Railroad Problem Be Solved." Mr. Bailey reviewed the events which led up to the formation of the Federal Reserve Bank, described its methods of operation and outlined its place in the financial structure of our country.

Mr. Bierd Asks that Roads Be Let Alone

In opening his address Mr. Bierd urged that the roads be let alone until their officers can bring them back to the point where they were prior to federal control with reference to their ability to meet the demands of the public for service. They are confronted not only with the problem of handling the traffic of today, but must also be prepared to handle that which will come in the future.

The American public is entitled to the best transportation system in the world. They are entitled to a transportation system capable of giving them service at the peak of American business. This country has been built on transportation and is dependent on the railways for its success. Its cotton from the south, its grain from the middle west and its fruit from the Pacific coast must be moved long distances to reach the consuming public. Without transportation these basic commodities are of little value.

The problems now confronting the railroads are largely those resulting from federal control and particularly from centralized control of labor matters, creating a breach between the employees and their managements. The centralization of these problems broke down the traditions and practices of a life time. It also broke down the competition between men to excel. These experiences should cause all railway officers to avoid any influence tending towards federal control, for our government is not organized to conduct private business and any attempts in that direction will lead to failure.

Solution of Railway Problem

Depends on Public Attitude

In speaking on the question as to whether the railway problem can be solved, Mr. Dunn stated that the answer depends upon whether railway officers properly perform their duty to the public, and whether the public will do its duty by the railways. So far as the superintendents and other officers directly engaged in the operations of the railways are concerned, the railway problem is being solved. No industry ever made a finer record of achievement than our railways have during the last three years, and no legislation has ever more completely been vindicated by the results secured under it than the Transportation Act has been. When the railways were returned to private operation three years ago, they had 2,010,000 employees. During the first three months of this year, they handled a record breaking business with 1,793,000 employees, a reduction of 217,000 men. This reduction in the number of employees represents a saving of almost \$400,000,000 a year in operating expenses. It is the increase in efficiency of management that has made possible this reduction of the number of employees which in turn chiefly has made possible the reduction of rates by which the public is benefiting.

A little less than a year ago, on July 1, 1922, the railway shop employees' unions went on strike against a decision awarding a reduction in their wages which had been made by the Railroad Labor Board. The purpose of that strike was to so cripple or actually interrupt the operation of the railways as to compel them to pay wages which the Railroad Labor Board had held unreasonable. This strike enormously increased the difficulties of operation. Many persons believed and some hoped and expected that it would break the railways down. In spite, however, of this strike, the railways during the last nine months have handled more freight than in any previous corresponding period in their history. The largest freight business ever handled before was in 1920. Since the beginning of the present year, the railways have moved 13 per cent more carloads of freight than in the same part of 1920.

While the railways, in spite of great difficulties, have been astonishingly successful in increasing the amount of business handled, their officers recognize the fact that there must be, within the next few years, a vast enlargement of railway facilities. The freight business of the United States has in the past increased about from 50 to 100 per cent in every period of ten years. There is no reason whatever for doubting that it will increase at least 50 per cent within the next ten years if the railways are expanded enough to handle it. There is today a serious shortage of means of transportation. In an endeavor to begin remedying it the railway executives have authorized expenditures aggregating \$1,100,000,000 to be made for equipment and permanent improvements this year. It is probable that if the railways are to keep abreast of the growth of the country's production and commerce, an approximately equal expenditure for improvements and equipment will have to be made annually for the next ten years. Of course, the railways cannot make the needed expenditures if they cannot raise the required new capital. They cannot raise it unless they can earn enough to pay interest and dividends upon additional stocks and bonds.

The most important question confronting the country is whether the public will let the railways charge the rates and make the net earnings necessary that they will be able to render to the shippers and producers of the country, all the transportation that they will require.

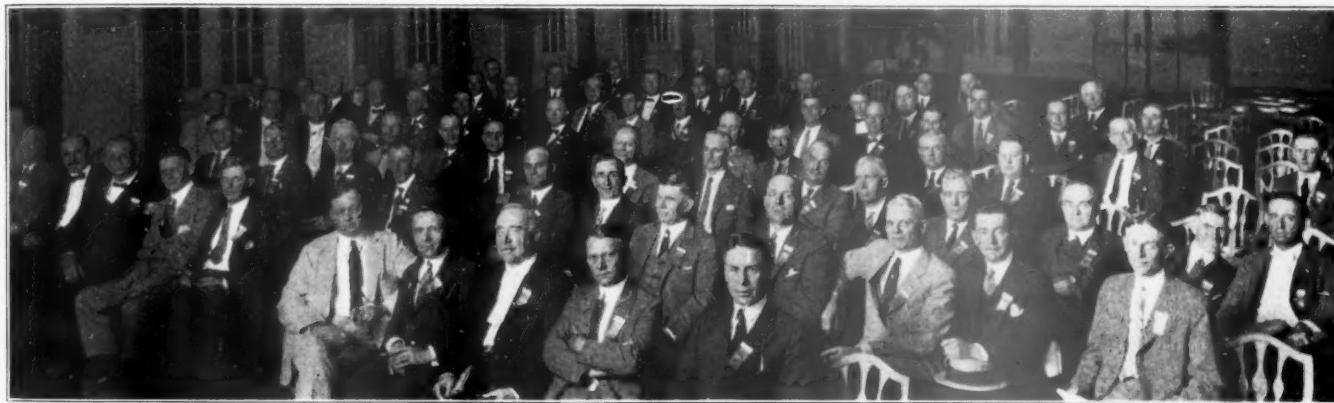
I need hardly tell you that at present there is grave doubt about this. For many years it was constantly charged by certain men that the railways were grossly overcapitalized and exacted excessive rates to pay dividends on watered

stock. They demanded that Congress should pass a law directing the Interstate Commerce Commission to make a valuation of the railways as a basis for the regulation of their rates. Finally in 1913, there was passed by Congress, a valuation law of which Senator LaFollette was the author. On the basis of the information gathered under this law the Interstate Commerce Commission has now placed upon the railways a tentative valuation of about \$19,000,000,000 and is trying to so regulate their rates as to enable them to earn a return of 5½ per cent upon this valuation. The tentative valuation made by the commission having proved to be actually larger than the capitalization of the railways, Senator LaFollette and others who advocated a valuation now denounce that made by the commission because, as they say, it should have been based entirely upon what it actually cost to construct the railroads. They propose in some way to secure action which will reduce the valuation.

Public sentiment will finally settle how the railroad problem shall be solved. Since the attacks upon the railways are sure to continue indefinitely, the only way to restore and protect their earning capacity, and thereby enable them to render the public good and adequate service, is constantly to present the facts about their management, operation, service and financial necessities to the public. This is primarily the duty of railway officers. It is just as much

is confined to the right-of-way of the railroad which he represents. The public has always inclined to the view that the superintendent is the real representative of the carrier on the division. To those intimately acquainted with the management of transportation, the constant wonder has existed why the superintendent did not, through the channel of personal acquaintanceship, take advantage of the situation to such an extent as to make the relationship between the carrier and its constituency so secure as to make impossible the many assaults which have been made upon transportation as a whole. My observation leads me to believe that the superintendent has unconsciously fallen into the rut of making himself believe that if he should momentarily desert the right-of-way some irreparable catastrophe would overtake his railroad. The average superintendent is a very important personage with the uptown clientele of the carrier and if he can so arrange his affairs as to devote a part of his time to the cultivation of that interest, the effect will be surprisingly pleasing to himself and redound favorably to the advantage of his company.

It is true that all well organized transportation lines are departmentally organized, so that it might well be said that what I have in mind properly belongs to some other department; but don't overlook the very important factor that the good will and the revenue flowing therefrom are what your



In the Convention Hall

a part of the business of railroading as the maintenance of equipment and tracks or the running of trains. It is not a duty which has been sufficiently performed in the past and it must be better performed in future if private ownership in this country is to survive.

There are many persons in this country as well as in other countries, who own no property themselves, who are too lazy or incompetent to acquire it, and who desire through a policy of confiscation to get a share in the property created by the energy, the ability and the thrift of others. But in this country, at least, these people are a minority, and once we make clear to the public the facts about the railroad situation and the true issues involved in the struggle over the railroad problem, the good, sound sense of the majority of our people will cause that problem to be solved in an honest and fair way and in a way that will promote the true welfare of the public.

The Superintendent's Responsibility Beyond the Right-of-Way

By J. R. Koontz

Vice-President, St. Louis-San Francisco

There has been a belief that the division superintendent of a railroad has in the past and probably to an extent still continues to labor under the impression that his jurisdiction

company is after. There is no justifiable reason for the superintendent of a division not knowing intimately every consequential user of our machine on the division and yet every now and then you find yourselves in the embarrassing position of having to be introduced to some shipper who has been on the division during all of your incumbency and probably that of several of your predecessors. Let me suggest that you cultivate assiduously the acquaintance of every person on your division. Find time at the more important points on your division where chambers of commerce exist to spend the noon-day lunch hour with the business men. Take an active interest in all civic affairs and affiliate, wherever possible, with such civic bodies as the Rotarians, the Lions, etc.

Also do not underestimate the value of the acquaintanceship of the country editor or the country banker. We are not trying to purchase good will through financial channels, but many a hostile sentiment expressed through the country newspaper would not have been made if there had existed close contact between ourselves and the country editor. The chances are that before indicting the transportation lines the country editor with his close acquaintanceship with the superintendent would have taken the time to drop him a note and ask him if the theme of his intended editorial or comment was based upon facts.

We have not as yet arisen to the full importance of our undertaking; we have been too much inclined to conduct or

close our transactions through the correspondence channel. It is true that a superintendent is not vested with supreme authority or anything approaching that ideal condition, but many years of intimate contact with transportation affairs leads me to say to you that I have yet to find any person who is vested with that supreme authority. I do not believe that it is any reflection upon you if you should be compelled to advise your constituents from time to time that a matter which they present to you is one for consideration by your higher officials. But where you so frequently fall down is when you convey to your constituents an impression that you are a passive rather than a forcible man.

Our great asset is service and the superintendents are a very consequential part of our "sales department." If by your action you do not contribute 100 per cent to your sales manager, then your company to the extent that you fall down suffers from competition with a company where all individuals are 100 per cent on the sales department enrollment.

I have always been impressed with the thought that there is within the keeping of the superintendent an immense power for good in the direction of welding together every available unit upon his division. We have our malcontents and possibly our "reds," but as compared with other great industries, we can say that, after all, there is a sufficiency of the good within our ranks to make possible a proper conduct of our relationships with the public. I feel that conditions in this respect are rapidly improving and to a very large extent the major of the improvement is with you.

We are not going to accomplish that which the country demands through the channel of pessimism or discouragement. In order to exert the influence which we should upon the country as a whole, our actions and words should be optimistic. Nothing contributes to the inevitable end of the patient so much as to be constantly advising him that his chances for recovery are remote. Let us take courage and do our part, just as those who had to do with transportation in the past have contributed theirs to the generation in which they belonged.

M. J. Gormley Told What Roads Are Doing

M. J. Gormley, chairman of the Car Service division of the American Railway Association paid a high tribute to the superintendents, through whose energy and loyalty the roads were able to maintain uninterrupted service during the shopmen's strike last year and to establish a new record for volume of traffic handled. He then referred to the present program of the American Railway Association and stated that the roads are now handling a traffic exceeding the A. R. A. estimate by 40,000 cars weekly. He urged the superintendents to tell their shippers that the roads have already handled over three million more cars of traffic this year than in the record year of 1920. He also stated that during the week ending May 26 when 1,014,000 cars were loaded, 40,000 empty cars were being moved west into the grain producing areas and that almost enough cars were now stored in the western states to move the season's crop.

Touching on the A. R. A. objectives of 30 miles per car per day and 30 tons per car, he called attention to the fact that an increase of one ton in the average car loading was equivalent to the addition of 80,000 cars to the supply, while an increase of one mile per car per day will add 100,000 cars. While the managements can buy cars, the effectiveness of their use devolves on the division superintendents.

Mr. Gormley also referred to the work of the public relations division of the A. R. A. and described its regional organization. He urged local operating officers to work closely with this division and to see that these advisory committees are informed fully about transportation conditions. Bearing on the local superintendent's responsibilities,

he stated that a recent analysis of a large number of complaints regarding inadequate service, received during the shopmen's strike last fall, showed that 95 per cent of them could have been settled locally if the superintendents had taken them in hand.

Joe Marshall Reviewed Freight

Claim Prevention Work

Joe Marshall, special representative of the Freight Claim Prevention department of the American Railway Association, addressed the convention on Thursday morning. He described the difficulties which confronted the roads in attempting to hold claims down by individual effort, stating that while freight revenues had increased 275 per cent in the last 10 years, the amount paid out in claims had increased 800 per cent. Through the co-ordinated action of all of the roads these claims are now being reduced. Mr. Marshall emphasized the fact that freight claims run in cycles, increasing for four years and then declining for two years. He emphasized the danger of drawing wrong conclusions from payments owing to the fact that they lag behind their creation, as a result of which it frequently occurs that claims decline during a rise of traffic while they frequently increase when traffic is falling off. Mr. Marshall stated that the greatest results are being secured by appealing to the shippers and enlisting their co-operation. He illustrated his talk by a series of charts showing the nature of the traffic giving rise to freight claims. In conclusion Mr. Marshall urged that the division superintendents give attention to the matching of "overs and shorts" at common points, that they solicit the co-operation of heavy shippers in studying the proper means of loading freight and that they investigate the permissible speed of coupling and limit switching to this speed.

The Beginning of Tonnage Rating

By L. F. Loree

President Delaware & Hudson

When the panic of 1893 came on I was superintendent of the Cleveland-Pittsburgh division of the Pennsylvania Lines West. The attention of everyone was sharply directed to producing economy in operation and saving every dollar possible, and the means of bringing this about were the subject of many consultations with the staff and much effort on the road. Among the other matters discussed was the question of saving locomotive fuel, which is always a very large item of transportation expense, and it was decided to take this matter up systematically. For many years the Pennsylvania had been paying a premium to engineers and firemen for the economical use of fuel, dividing the value of the coal saved, based upon an arbitrary allowance of so many pounds per engine mile and so many pounds for each car moved one mile by the engine. I found upon investigation that this premium system had suffered from what has been the destruction of so many of the piece-work and premium systems, namely, that as a man began to earn what the clerks in the motive power department thought were unwarranted amounts, they changed the basis of rating, so that the first thing I did was to secure an arrangement with the superintendent of motive power that the basis upon which we agreed should not be disturbed until the end of the experimental period. We divided the year into two halves, throwing October into the winter district because of the condition of the rail caused by falling leaves, etc. As there were a large number of men to supervise and many of them were expert in their work, we utilized the information in our possession from the premium records and concentrated our attention each month on the ten men who had been at the bottom of the list the preceding month. We effected a

saving during the year of 18 per cent in the amount of coal used.

It soon became apparent that the result depended not only upon the skill with which the engine was handled and fired, but upon the character of the cars that were being hauled, which varied in weight and in ease of running. I, therefore, undertook to determine what seemed to me to be the internal resistance of the car as a vehicle as distinguished from its resistance due to weight, and moved two trains south from Cleveland, one composed entirely of loaded cars carrying iron ore which had been carefully weighed at the docks, and one consisting entirely of empties, the total weight of which was exactly equal to the preceding train. The result was somewhat surprising. In going down the grades of 40 ft. to the mile the crew had to set up the brakes on the loaded train to steady the train down the hill. In going down the same grades the engine pulling the empties had to make steam to pull the train down the hill. A contrast of these conditions, worked out by a simple algebraic question, gave a weight measure of seven tons per car as the resistance of the vehicle independent of its own weight and the weight of the lading.

We subsequently worked out, by dynamometer tests, the resistance on a variety of grades throughout the system. Upon severe grades, such as two per cent, where the power exerted by an engine was largely used to overcome gravity, this resistance, expressed in weight, was as low as two tons. On divisions with low grades, such as 0.3 per cent, where the force of gravity was exerted in very low degree, this resistance, expressed in weight, ran as high as 15 tons. It was evident that so potent a factor could not be ignored. This led to the rating of the engine by adjusted tonnage, taking into consideration the number of vehicles in the train, as well as the weight of the vehicles and their loads, and the grades to be overcome. This recognition of resistance offered by the car itself led to instant recognition of the great economies to be gained by concentrating the load into fewer vehicles. The experiments further brought on the relatively larger work that could be done by an assistant engine, the internal resistances of the cars in the train being the work assigned to the first engine in its rating.

Get Your Facts

In a paper on this subject, W. G. Besler, president and general manager of the Central Railroad of New Jersey, emphasized the importance of one's knowing the facts before attempting to answer a question. The trouble with a great many who are asked to solve a problem or question is that they do not look below the first letter or two in the file which reaches them, and the result is a faulty conclusion, which need not have been rendered, if, perhaps, by looking down through the file fifteen or twenty letters deep, they had there found the answer contained in some letter or, perhaps, a paragraph written by some one who knew what he was talking about. In transmitting a report, let it be short, sharp and to the point. A half a dozen declaratives of from three to five-line paragraphs will do more to establish a reputation than an essay of half a dozen pages. "Yes" and "No" are answers, and if you know your facts, need not be qualified, unless challenged.

Train Rules Committee Advocates Use of 19 Order

The Committee on Train Rules incorporated in its report a paper prepared by Victor Parvin, superintendent, Ann Arbor, Owosso, Mich., advocating the more extensive use of the 19 order from which the following is abstracted:

"In my early days as a train dispatcher, I became very much in favor of the exclusive use of the 19 order and after using this order for two years on the Ann Arbor railroad and without surrounding it with any extra safeguards such

as automatic signals, I am thoroughly convinced that it is not only safe but necessary for economical operation. In my opinion, single track railroads cannot do any one thing today outside of installing automatic block signals that will speed up train movements as much as the exclusive use of the 19 train order.

"One of the most important functions in handling train orders is to insure their delivery. The delivery of a train order is accomplished through the medium of the red board and the telegraph operator. The non-delivery of train orders results from the failure of the crew to observe the red board or failure of the telegraph operator to deliver the order after he has copied it. I see no reason why the non-delivery of an order would result any oftener from the use of the 19 order than from the 31. Once delivered, there is no reason why a train crew is not going to read, understand and comply with a 19 order the same as a 31 order.

"It has been my experience that to divide or in any manner lessen responsibility brings about inefficiency and a lower morale. I have never seen anything put the train crews and telegraph operators on the qui vive as much as the use of the 19 train order. The telegraph operator is on the alert to make delivery of the order and is much more careful in the issuance of his clearance cards. The train and engine crews keep a very close lookout approaching train order stations in order that they may be in a position to receive the orders when handed up and when the orders are delivered, the train and engine men give their first attention to the clearance card to know that it compares with the train orders received. In case it does not, the train is stopped immediately and the error corrected.

"When placed at point of execution the 31 order cannot be made safer than the 19 order as our rules require that trains be brought to a stop before the order is delivered and in the case of the 31 order there is no more assurance that the train will stop at the restricted point than in the case of the 19 order, as both are dependent upon the display of the red board by the telegraph operator and the observance of this red board by the train and engine crews.

"We do not use the middle order in connection with the 19 order. Personally, I have little faith in the middle order for the reason that it cannot always be issued at meeting points due to closed offices or non-telegraph offices. There is no question in my mind but that the men are more careful in handling their orders when the middle order is not in use than they are when it is, as they are bound to take advantage of the second notice which they expect to receive regarding their meeting points. In my opinion, the middle order is in a class with the 31 order as it is used on many railroads where even the telegraph operators are permitted to sign the conductor's name, which defeats the purposes of the order. This violation of the intent of the 31 order is not only due to the action of the employees, but I have known it to be encouraged by division officers."

Research by the committee indicates the gradual use of the 19 order on various railroads, eliminating the use of the 31 order entirely or in part. Some exceptions are reported as follows: (1) To protect an unsafe condition of a railroad; (2) to act as a holding order; and (3) receipt for new time table.

The use of the 19 order in absolute permissive block signal territory has expedited train movement and effected economies reported by one line of 65 miles, amounting to \$12,000 per year in overtime, fuel, etc., without allowance for damage to equipment on account couplers pulled out, etc., due to stopping and starting trains. The principal lines discontinuing the use of the 31 order all report favorable results, statements being to the effect that not a single accident has occurred due to the use of 19 order, while a

material improvement has been effected in the movement of trains and resultant economies.

Discussion

In opening the discussion on this paper, W. S. Williams, general superintendent, I. C., expressed hesitation about abandoning the 31 order. P. B. Luke, general manager, Canton railroad, Baltimore, Md., stated that when on the Virginian railway he found that the heavy trains operated on that road lost 30 minutes every time they were required to stop to sign and pick up a 31 order and that this time was saved when the road adopted the 19 order in its place. V. Parvin, superintendent, Ann Arbor, stated that the overtime of train crews was reduced from 30 per cent to 6 per cent following the adoption of the 19 order and that the trainmen favored this change although it increased their individual responsibility. This road operates without automatic signals. J. M. Reines, trainmaster, C. G. W., stated that the 19 order has been used exclusively on the Eastern division of that road for the last three years. Although this division has been entirely equipped with automatic block signals, the results have been so satisfactory that he advocated the use of the 19 order on lines without signals. His experience led him to believe that the 19 order is safer than the 31 order because it makes the operators more alert and reduces the chances of a train running by a train order board. Before clearing the train order board for a train for which he holds a 19 order, an operator is required to secure a release from the dispatcher and a clearance card carrying a serial number and showing on it the numbers of the train orders to be delivered with it. Mr. Parvin opposed the use of the clearance card on busy dispatcher's tricks,

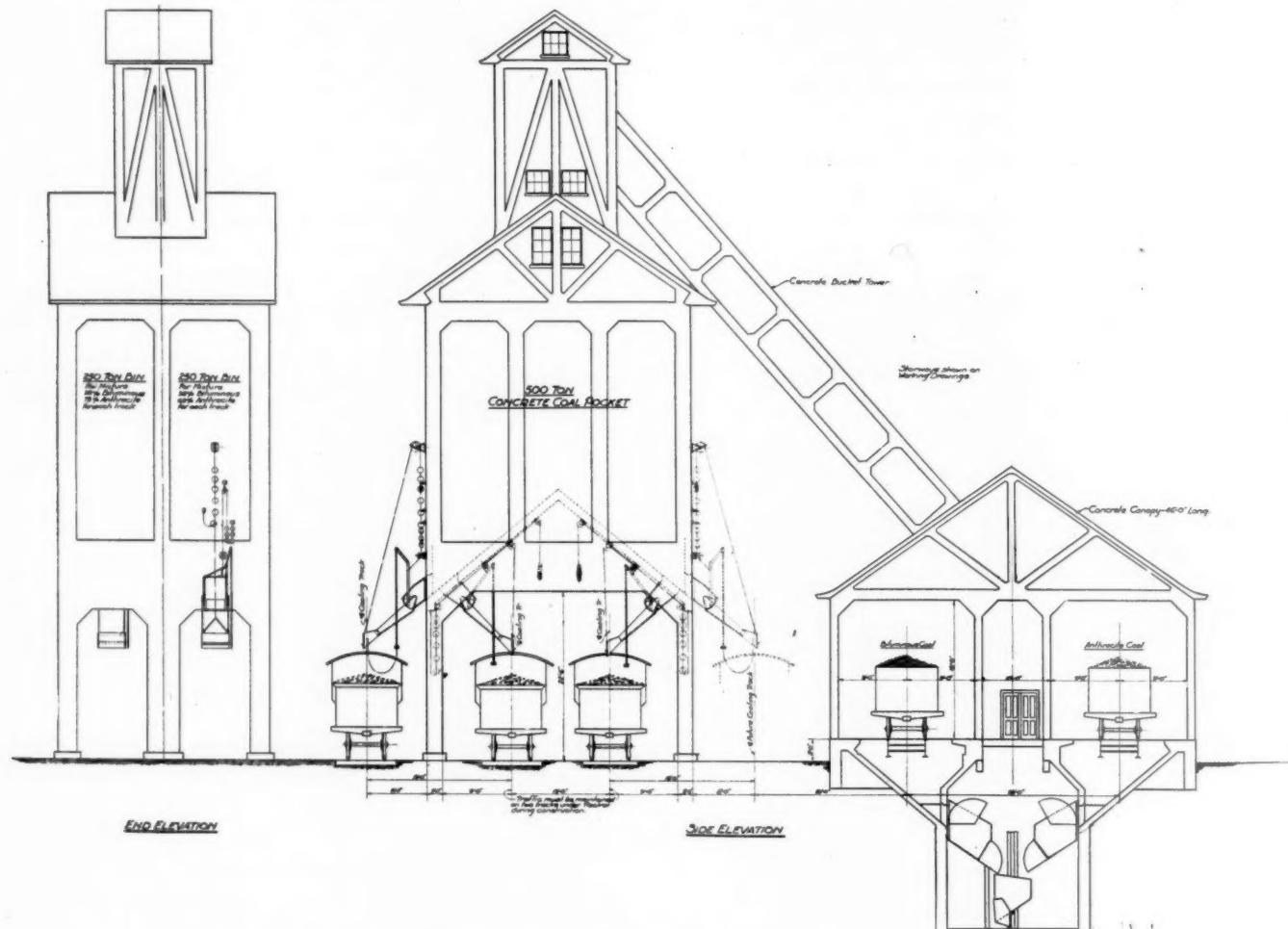
fearing that this release would be perfunctory. In its place the Ann Arbor requires an operator to bring a train to a stop before delivering to it an order restricting the movement of that train at that station. H. G. Hulze (N. P.) stated that the Northern Pacific has used the 19 order since 1912 on automatic block, manual block and non-signaled lines alike. A yellow board or the middle position of a three-position signal is used to indicate the delivery of train orders unless these orders restrict movement at that point when the red or stop board is used.

Officers Elected

The following officers were chosen for the ensuing year: President, W. S. Williams (re-elected), general superintendent, Western lines, I. C., Waterloo, Iowa; first vice-president, E. H. Harman, superintendent, Terminal Railroad Association of St. Louis, St. Louis, Mo.; second vice-president, G. O. Brophy, assistant to general solicitor, Union Pacific, Omaha, Neb.; secretary-treasurer, J. Rothschild (re-elected), Terminal Railroad Association of St. Louis, St. Louis, Mo.; chairman executive committee, Charles Burlingame, superintendent, Terminal Railroad Association of St. Louis, St. Louis, Mo. Buffalo was selected as the location for the next convention.

The association adopted a resolution to the effect that it opposed by every means at its command and disposal, the plan of government ownership of the railroads of the United States and of propaganda of any kind that might result in such ownership or control.

[Other reports and papers which were presented and discussed at this convention will be published in a subsequent issue of the *Railway Age*.]



General Elevation Diagram of the South Junction Station (See Article on Facing Page)

New Coaling Station Mixes Fuel Automatically

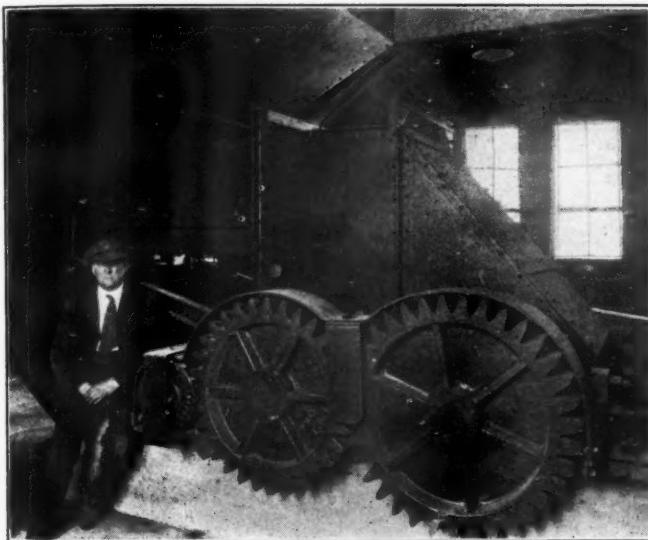
Accurate Proportioning of Anthracite and Bituminous Accomplished with Simple Equipment

THE MIXING of mine run bituminous coal with pea anthracite coal with the aid of patented automatic mechanical equipment as conducted in the Delaware & Hudson coaling station at South Junction near Plattsburg, N. Y., is receiving wide attention from railway officers, par-

jected to long use in many railway coaling stations throughout the United States.

A study of the conditions imposed in the mixing of coal of varying moisture content and granular composition gave rise to the conclusion that the only practical methods of obtaining the desired result lay in the mixing of relatively small quantities of the two kinds of coal and that this could best be accomplished by depositing in a relatively small container the contents of two other containers loaded by volume measurement with the requisite quantities of the two kinds of coal respectively.

The conditions thus imposed have been met without the introduction of any additional operation in the process of receiving the coal in the track hopper, the feeding of uniform charges into an elevating bucket and the delivery of the

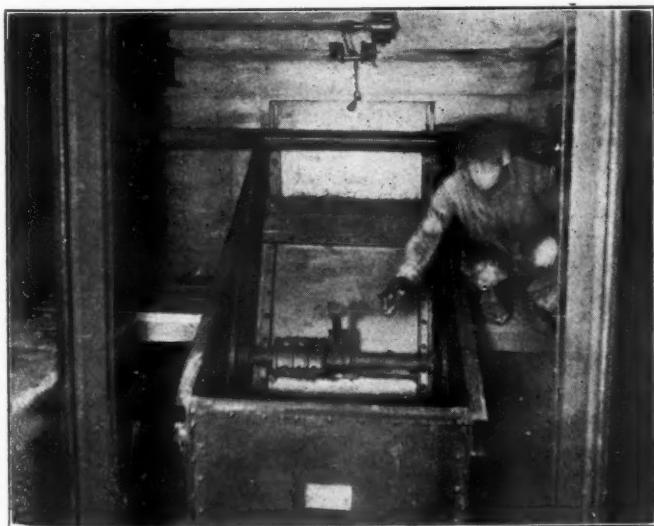


The Coal Crusher Is Located Over the Storage Bin

ticularly those who have been concerned with the perplexing problems of coal mixtures. In the Delaware & Hudson station the mixing is accomplished with the use of the standard coal handling equipment of the Roberts & Schaefer



A Station for Mixing Anthracite and Bituminous Coal



A Screw Adjustment Varies the Volume of the Measuring Feeders to Suit the Proportions Required

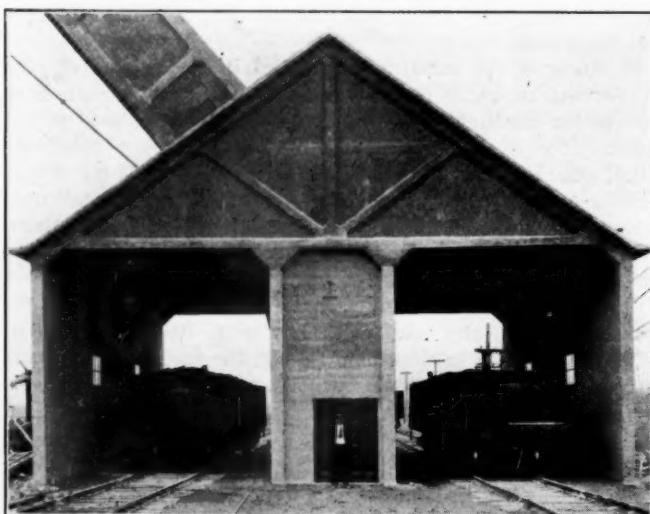
Company, the firm which erected the coaling station, the modifications required to provide the necessary facilities for the special operation of coal mixing being of such a minor nature that the new station may be said to embody little mechanical equipment which has not been previously sub-

bucket to the point of dumping over the top of the storage bin. The only change has been to provide two track hoppers, one for receiving the anthracite coal and the other for the bituminous coal, the Shraeder automatic measuring feeders, by means of which the coal is delivered to the elevating bucket, being made to serve as the proportioning devices for mixing the coal. The bucket itself is utilized as a receptacle for the receipt of the mixture from the two feeders.

To provide means of varying the proportions, two Shraeder measuring feeders were equipped with diaphragms or vanes made to swing out from one of the walls so as to cut off a portion of the volume of the chamber and thus change the amount of coal of one kind or another being delivered to the elevating bucket. The position of this diaphragm is controlled by a screw provided with suitable calibrations so that the proportions of the mixture may be controlled at will. The operation does not vary from the usual arrangement. The elevating bucket, which has a capacity

of three tons, descends between the two track hoppers and in so doing opens the two measuring feeders, causing the two grades of coal to flow from each side at the same instant and effect a thorough mixture.

The two track hoppers are housed in a separate building, from the top of which an inclined hoistway extends to the top of a tower on the coal storage bin. Here the coal is dis-



Anthracite Coal Is Received in One Track Hopper and Bituminous in the Other

charged into a fixed equalizing hopper from which it is fed to a combined Beaumont double roll crusher with reciprocating feed so that the mine run coal is crushed between the rolls into four-inch cubes and the mixture of the two grades deposited in a 500-ton storage pocket, where it is available through undercut lever type coaling gates and hooded aprons to locomotives on four tracks.

In addition a by-pass arrangement is provided together with a partition in the pocket so that either anthracite coal or bituminous coal, separately crushed or mine run, may be deposited in the pockets without operating the crusher which is electrically-driven. The crusher is supported in such a way that no vibration has been noticed in the operation of the station and dust from the crusher operation is readily retained within the bin structure.

The plant operates at the rate of 75 tons per hour, performing the operations of both mixing and crushing. The

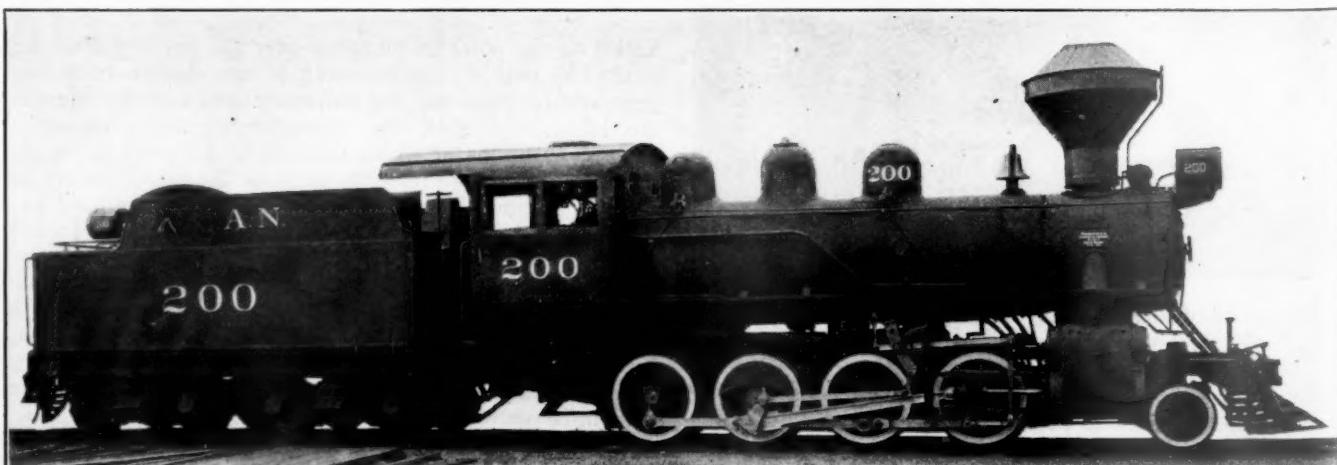
proportions of the mixing can be modified from a ratio of 65 per cent bituminous coal and 35 per cent anthracite, to a ratio of 25 per cent bituminous and 75 per cent anthracite. The plant is equipped with a Roberts & Schaefer direct-connected, spur-gear driven electric hoist, connected to a 25-hp. General Electric motor, equipped with solenoid brakes. A Cutler-Hammer automatic controller provides for the continuous ascent and descent of the elevating bucket, push button control being provided both at the top of the pocket and in the hoist house for the stopping and starting of the motor.

The structural portions of the station are of reinforced concrete construction throughout, special pains being taken to secure a good finished appearance, both through care in obtaining a good surface treatment of the concrete and through the use of paneling designed to overcome the effect of the large flat surfaces which ordinarily prevail in such structures.

Auxiliary to the coaling station, a sand handling plant has been provided in a reinforced concrete house. This plant provides ground storage for 100 tons of wet sand, the housing of a coal burning sand dryer, together with equipment for the pneumatic handling of the sand to a 10-ton dry sand storage bin. Moisture-proof, undercut sand valves and telescoping spouts are provided for supplying dry sand to engines on four tracks. Wash bowls, toilets, etc., are provided in a separate room for the use of the attendants of the coaling station.

This plant was built under the jurisdiction of Col. J. A. McGrew, general superintendent equipment and way, and H. S. Clarke, engineer maintenance of way of the Delaware & Hudson. The contract for the entire plant, including the designing and erection of the foundations and buildings, was placed with the Roberts & Schaefer Company, Chicago, the work being directed by Charles Corwin, construction superintendent. The plant was completed in May, 1923.

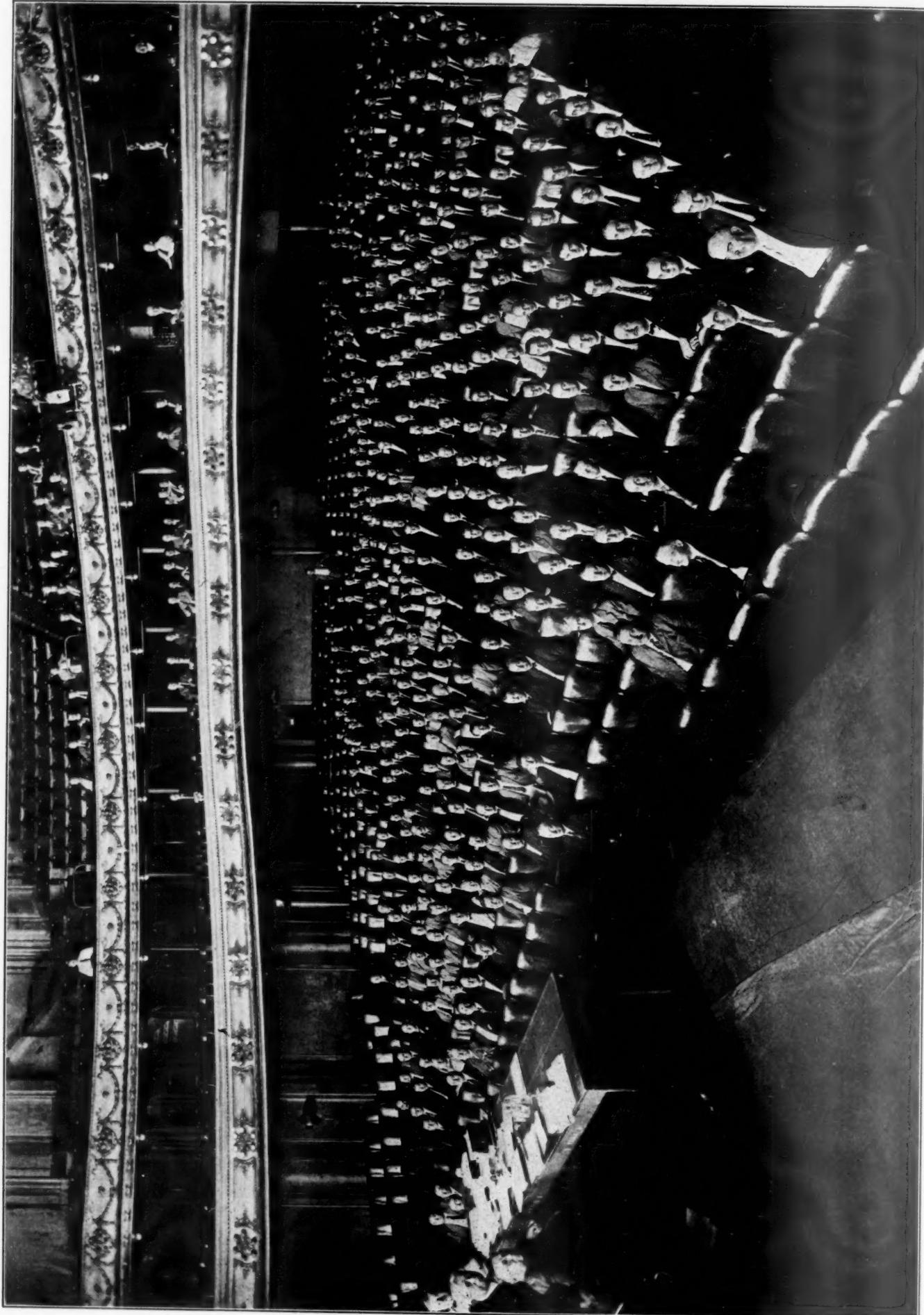
PRIZES AGGREGATING \$6,500 have been offered by the National Automobile Chamber of Commerce to school children and teachers for essays on how to promote safety on the highways. The first prize is a trip to Washington for the best essay by a pupil and best lesson by a teacher; and in addition, the pupil will receive a gold watch and the teacher will receive \$500. Second and third prizes are offered, and smaller prizes are to be given in each state and territory. Information concerning the contest may be had from the Highway Education Board, Willard Building, Washington, D. C.



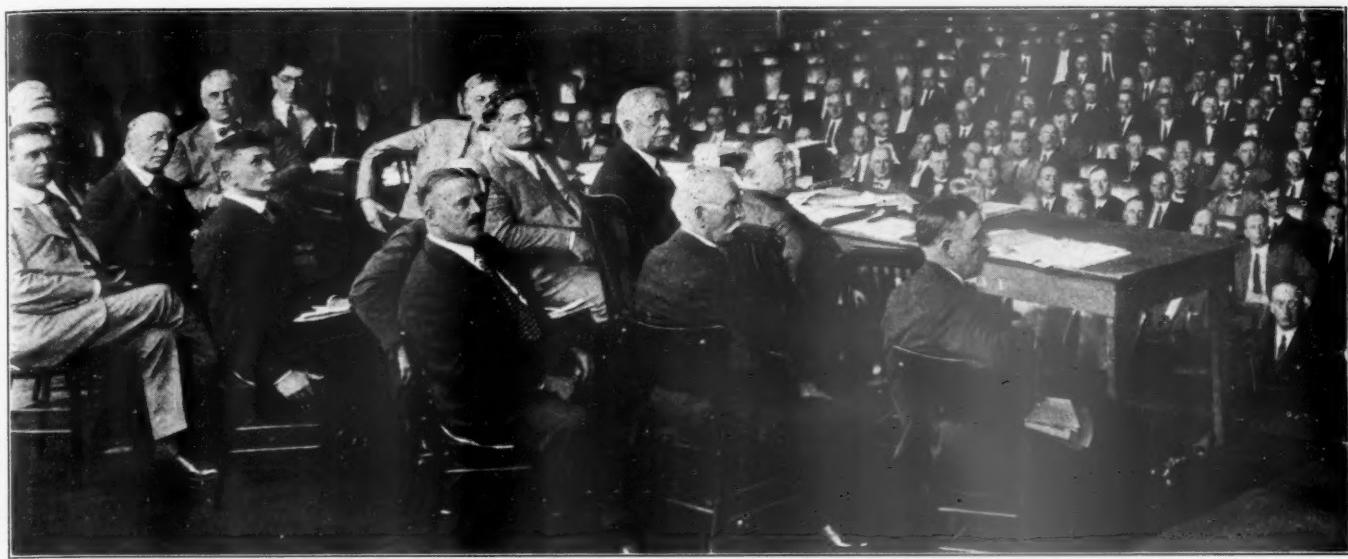
Small Consolidation Locomotive on Apalachicola Northern, Built by American Locomotive Company

PROCEEDINGS OF
DIVISION V-MECHANICAL
AMERICAN
RAILWAY ASSOCIATION

CHICAGO
JUNE 20-22, 1923



Mechanical Division Meeting at First Session on Wednesday Morning



Officers and General Committee on Platform. (This Completes Photograph on Opposite Page)

Comments on the Mechanical Division Meeting

"The proof of the pudding is in the eating." For 16 years the Santa Fe has maintained a modern apprenticeship course,

Modern Apprenticeship Methods including the careful selection of apprentices, special shop instruction and comprehensive school room instruction in the theory of the trades. Today

over 200 of its graduate apprentices hold supervisory positions on that system and the management is more enthusiastic than ever over the substantial and practical results which have been obtained. Too much credit cannot be given to those who had the vision to continue the work through thick and thin—sometimes under most discouraging conditions. It is a good sign that so many roads are now studying the Santa Fe apprenticeship methods; Mr. Purcell's paper proved to be one of the most distinctive features of the meeting. A comparatively new development on the Santa Fe is the emphasis which is now being placed on special apprenticeship. In Mr. Purcell's own words: "The purpose of this special apprentice course is to supply the practical experience, without which the college man's technical education is of little value in railroad work. We have some excellent material now as special apprentices and are in the market for more of them." There has been a lot of discussion about the use of college graduates by the railroads; as a matter of fact, college men in the mechanical department have given a good account of themselves. It is high time, however, that orderly steps were taken to attract and utilize these men to the best advantage.

There has not been too much explaining and refuting done on behalf of the railways. Things the public does not understand must be explained. Misrepresentations must be refuted. But there

Tell What the Railroads Are Doing has been much too little of telling the public what the railroads have done for the country, what they are doing for it

now, and how they are increasing the safety, the economy and the efficiency of operation. In recent months they have been making a splendid record in handling the country's commerce under adverse conditions. President Aishton of the American Railway Association dwelt upon this in his address at the opening session of the convention of the

Mechanical Division. He said the railways within recent months have made the finest record in point of efficiency of operation in their history. He gave detailed facts in support of this statement. There ought to be more speeches like that of Mr. Aishton's made by railway officers. The best defensive is a vigorous offensive. The railways have been on the defensive too long and too much. Railroad matters always have been and always will be discussed because they are of great public interest. In the past they have usually been discussed first by the enemies of the railways, who have made all manner of charges against them, and then answered (sometimes!) by railway officers who have defended the railways from the criticisms made. It is time to reverse this order of things. Let us tell the good, the big, the constructive things the railways are doing and want to do, and leave it to the enemies of the railways to do the answering for awhile. If railway officers would say more things for the critics of the railways to answer, their critics would not be able to give railway officers so many things to answer. There is a tradition in the railway business to the effect that their officers should not talk in public. It is a fool tradition. The sooner it is forgotten the better. In telling what the railways are achieving Mr. Aishton has set a good example for railway officers of every rank.

General Atterbury's hearty commendation of the work of the mechanical department officers during the trying experiences of recent years was greatly appreciated by the convention attendants. While he did not attempt to

Mechanical Officers Commended review in detail the handicaps under which these officers have had to work,

he did characterize their difficulties as almost insurmountable. The "acid test" has been and is being applied by the record-breaking business which the railroads have been called upon to handle in recent months. It was predicted that the shopmen's strike would cripple the railroads beyond the possibility of recovering in time to handle the peak business this year. However, they have already handled business during the first five months of this year which surpasses the records for the same months of any previous year and, indeed, are within a very small percentage of the peak load

which has been handled during the fall months of previous years; moreover, they have already made splendid progress in providing for the large business of moving the crops this summer and fall. This has been made possible by almost superhuman efforts to restore the equipment to good condition. The public, and possibly most railroad officials, do not have any adequate conception of the intensive and long continued efforts on the part of the mechanical department officers and foremen which have made this recovery possible. Let us hope that the railroad executives generally will agree with General Atterbury in his tribute and then tell their own subordinates how much they appreciate the good work that has been done on their individual roads. Some mechanical department officers who have given to the very limit of their strength and endurance have not had very much in the way of expressions of commendation to inspire them. True, the executives have had more than their own share of troubles, which have doubtless interfered with their finding time and opportunity to freely express their appreciation to their associates. A little intelligent commendation at this time, however, will go a long way in helping to achieve the goals which have been set by the American Railway Association.

Mr. Storey's Address

W. B. STOREY, president of the Atchison, Topeka & Santa Fe, in his address to the Mechanical Division, especially emphasized two things. Mr. Storey, who is executive member of the American Railway Association for the Mechanical Division, commented both favorably and adversely upon the work of the committees of this division. He pointed out that some of the committees have been doing good constructive work, while others have been doing little or nothing. Both the quantity and quality of the work done by every association depends primarily and mainly upon the work of its committees. They must make the investigations, compile the information, draw the conclusions and make the constructive suggestions. Without good committee work, the conventions of any association will be of relatively little value to the members and comparatively unproductive of practical results. Mr. Storey's remarks upon this phase of this work should have a very invigorating effect upon the committees of the Mechanical Division.

The second point Mr. Storey emphasized is that the future of the railroads depends largely upon public opinion, and that it is just as much a part of the work of the mechanical officers as of any other railway officers to help form a public opinion that will be friendly to the railroads and helpful to them in providing and rendering their service to the public. They can improve public opinion by giving correct facts and talking sound sense to the employees as well as to their neighbors. As Mr. Storey intimated, however, railway officers cannot do this unless they inform themselves concerning the facts regarding railroad matters that are in controversy. As the *Railway Age* repeatedly has pointed out in the past, the net earnings of the railways do not depend, under present conditions, merely on the efficiency and economy with which they are developed and operated. They depend also on how they are regulated, and public opinion determines that. Now, while every railway officer recognizes the fact that it is his job to help develop and operate them efficiently and economically, a very large part of railway officers have not, in the past, recognized the fact that it is a part of their job to help form a public opinion favorable to letting the railroads earn reasonable profits when they are efficiently and economically managed. Helping create a sound and friendly public sentiment is a part of the every-day work of every railroad officer just as truly as is maintaining equipment and tracks and running trains. It is gratifying to have this fact emphasized by so eminent an executive as Mr. Storey.

Adopt the Car Construction Committee Report

AFTER YEARS of hard work and patient negotiations, the Car Construction Committee has finally presented designs for standard all-steel and single-sheathed steel frame box cars of both 40 and 50 tons' capacity and the Mechanical Division, at its annual meeting, with certain amendments to establish more definitely the extent to which alternate details can be used, has voted to submit them to letter ballot. This question was first brought to an issue through the efforts of the late E. P. Ripley, president of the Atchison, Topeka & Santa Fe in 1915, through the old American Railway Association, and although progress was greatly hindered by the war, the matter has been constantly under consideration since that time.

Several reasons have been advanced why standard box car designs should be established. The one which probably had the most influence in bringing the matter to an issue was the need for interchangeability of parts in repairing foreign cars. Next in importance to this is the need for the elimination from interchange of cars of weak design. While such cars are built that may be adequate to meet the service conditions on the home road, they cause an endless amount of damage and expense when operating under more severe conditions in territories where traffic is dense. With cars averaging half their time on foreign lines, the control of this situation becomes a matter of the most vital interest to the railroads as a whole.

Much has also been said about the possibility of reducing the first cost of new equipment by the establishment of standards which will permit the builders to stock certain materials.

There are, however, limitations on the extent to which complete standards can be made effective. The character of the traffic loaded on the railroads in various sections of the country requires equipment of special design either as to size of details, such, for instance, as the demand for end doors for lumber loading in the northwest. There will also be a strong disinclination to give up the use of many details considered standard by the individual roads. The maintenance of alternates for some of these details is desirable, not only to satisfy the desires of the various railroads, but for commercial reasons as well. Many of these parts still subject to further improvement and the maintenance of competition is necessary for healthy development. Fortunately the standard cars are so constructed that they will allow plenty of latitude for the introduction of various new designs of detail parts.

The present Car Construction Committee has probably presented the best designs which could be developed by any committee without service experience with the designs, and it is encouraging that these designs were received with so little damaging criticism that the Mechanical Division voted to submit them to letter ballot with no amendments except those required to eliminate the possibility of misunderstandings as to the use of alternates. No fundamental reasons have been offered why standard designs should not eventually be adopted and the railroads now have the best opportunity to adopt them ever likely to be presented. The extent to which they ultimately will prove desirable can never be definitely established until a large number of cars are in actual service and only on the basis of such experience can the details be perfected. The railroads should, therefore, not only adopt the designs by letter ballot, but should proceed to use them when ordering new equipment. By so doing they will demonstrate their ability for effective unified action through which ultimately they may expect to accomplish all that could likely be accomplished in the way of greater efficiency by any practicable plan of central ownership or control of equipment.

The Mechanical Division and Its Future

There seems to have been some misunderstanding about the nature of the meeting of the Mechanical Division at

Chicago. The General Committee de-

A

cided last winter not to hold the usual

Little

convention this year, but rather to

Misunderstanding have a business meeting at which those matters requiring immediate attention could be disposed of. The shopmen's and coal miners' strikes, the equipment condition and the fast-growing traffic due to the business revival had taxed the mechanical department officers to the very limit of their endurance and there had been no time for the preparation of committee reports.

It appears, however, that when the actual work of laying out the program was taken up conditions had improved very considerably. It was found, for instance, that certain important committees were prepared to report notably the Car Construction Committee whose recommendations required prompt consideration. Then too it became apparent that in spite of all the handicaps and the abnormal traffic, equipment conditions were steadily improving—in other words, the mechanical departments had matters well in hand and were giving an excellent account of themselves.

It was decided, therefore, to enlarge the program and make it more comprehensive. Several individual papers were arranged for, two from railway equipment manufacturers, and others from railway officers on such vital topics as the training of apprentices and the better utilization of locomotives. It was recognized also that the railroad question was coming to the fore in the political world and that the mechanical officers must study to do their part in helping to improve the relations with the public. Several chief executives were invited to address the members on this and other large questions of policy. The simple business meeting, as at first projected therefore developed into a live energetic conference (in spite of the heat and other handicaps) with a program which was equal in some respects—and even surpassed in others—the programs of previous years. Had this development been more widely recognized and understood, the attendance would undoubtedly have been larger than it was.

* * * *

Under the circumstances the attendance of nearly 600 railroad men was most gratifying. The spirit of the conference, however, was even more so.

A

Hard Working
Bunch

Here was a group of men who had put forth almost superhuman efforts for at least 12 months in one of the greatest crises through which the railroads of this country have ever passed; they had been in the trenches, so to speak, and at the very front line. They still have months of intense effort ahead of them until the peak load is passed next fall. They came for help and suggestions in order that they might make better use of their facilities and that they might improve the effectiveness of their organizations. Is it any wonder that they literally "took off their coats" and went at things "with blood in their eyes?" Yes, it was a worth-while conference—three days with two long sessions each, and lots of informal but productive conferences on the side.

* * * *

It is difficult to point out the high spots in the three-day meeting—so much depends on the point of view. The proceedings which are fully reported on

**High Spots
of the
Conference** the following pages will disclose many things. Naturally the recommendation for standard cars by the Car Construction Committee occupied the center

of the stage, but several other reports drew forth long and constructive discussions. The messages from General At-

terbury and Sir Henry Thornton were greatly appreciated. The addresses by Messrs. Aishton, Storey and Markham were helpful and inspiring and were received with the greatest enthusiasm—and it is extremely doubtful if these men—busy as they are—could have put in their time to better advantage than counselling as they did with the chiefs of their mechanical departments. The splendid reactions to the individual papers indicates the importance of giving special attention to this feature for future meetings. This is particularly true also of the six topics which were scheduled for discussion. These were wisely selected; naturally the last ones on the program suffered somewhat because of the time limitations, but most of them drew out concrete suggestions of real value.

* * * *

As a whole the meeting may be said to have been characterized by the practical value and extent of the discussions

**Discussions
of Exceptional
Value** of the reports and papers. On the face of it, this would appear to be a preposterous statement. How could such a thing be true, you ask, when the reports

were so late in getting to the members? You have visions of the old days when the reports did get out a little earlier—the delay was absolutely unavoidable this year—but when prominent members embarrassed the meeting by betraying inexcusable ignorance of the contents of the report which they were attempting to discuss. This year the greater part of the discussion was intelligent, constructive, and right to the point. Why? Because the officers of the division asked men who were specially qualified to discuss each report to prepare discussions in advance and to be prepared to present them in writing. The scheme worked—worked so well and so raised the standard of the discussion that the practice will undoubtedly be continued and extended.

* * * *

Sometimes we clean our minds by the asking of simple questions—so simple that they appear almost foolish. What

**What is
the Division
For?** is the Mechanical Division for? Some say to develop standards and recommended practices in order that the railroads may co-operate to better ad-

vantage and individually operate more efficiently. This is indeed a worthy object. Important as it is, others believe that the division has an even greater objective, which, however, is not so clearly or generally recognized as it should be. Standards and recommended practices are concerned largely with materials and the physical plant; they do not take into consideration the human element which is far more important than the physical plant. We get some idea of this from the discussion on "Shop Management Problems of Today." Some members felt that Mr. Demarest's talk and Mr. Bentley's contribution hit the very high spot or peak of the entire three days' conference.

If we look at the question in this light, is it not true that the division can best serve the railroads, if it studies to develop itself into a great educational force—a force which will reach out and educate and inspire every supervisory officer and ambitious young man in the mechanical department to larger service and higher ideals. What have not some of the conventions of the M. M. and M. C. B. meant to young men who are leaders today, but who caught their first inspiration at these meetings? What have not some of these meetings meant to the foreman or subordinate officer who worked in narrow confines with a limited vision, and was then fortunately privileged to attend one of the con-

ventions? Does not the Mechanical Division have a wonderful opportunity in awakening and firing the ambitions of these men? How can it better discharge this responsibility?

* * * *

John Purcell, the new chairman of the Mechanical Division, has always taken a keen interest in the development

**Use
the
Young Men**

of boys and young men. This is wise, for while an organization needs the experience and wisdom of the older men to guide and stabilize it, it must constantly recruit new blood in the way

of young men with their intense energies and large visions. It was good to hear the new chairman make the declaration that a special effort would be made during his administration to enlist the more active service of the young men in the work of the division. Young men, here is your opportunity! Mr. Purcell is in deadly earnest. Will you rise to the occasion and make good? The division is going strong, but it needs you, and you must go in more active training to carry it on when you assume leadership in the future.

* * * *

The new vice-chairman, Mr. Goodnow, lost no time in backing up Chairman Purcell. He frankly asked for suggestions as to "live wires" who could

**Looking for
New
Blood**

be assigned to committee work. Most men are probably too modest to write and ask for such an assignment, but how about their friends. Mr. S. M. P.,

who are the bright, live men in your organization who should be drawn out of their shells and enlisted in the work of the division? Something is wrong if you cannot make several splendid suggestions to Mr. Goodnow. Mr. Supply Man, you are traveling about and know where there is a lot of real talent down the line. We venture the guess that Vice-chairman Goodnow will be appreciative for some tips from you. A glance over the roster of the minor mechanical department associations will also disclose some first-class talent.

* * * *

To those who have advocated holding the mechanical conventions in Chicago, the meeting this year must have been a keen disappointment. Unfortunately,

**Some
Disagreeable
Features**

the hall proved very poorly adapted for such a meeting because of its peculiar acoustic properties. Those who sat at the sides or rear had great difficulty in hearing the speakers and could not understand what was said by those who spoke in a low voice.

But the most disagreeable feature of the meeting was the stifling, enervating heat that prevailed day and night while the members were in attendance. After experiencing three days of such weather there are very few who would be in favor of holding an eight-day convention in Chicago.

* * * *

A good or a bad convention hall is a large factor in the success or failure of a convention. It speaks mighty well

Specifications

**Badly
Needed**

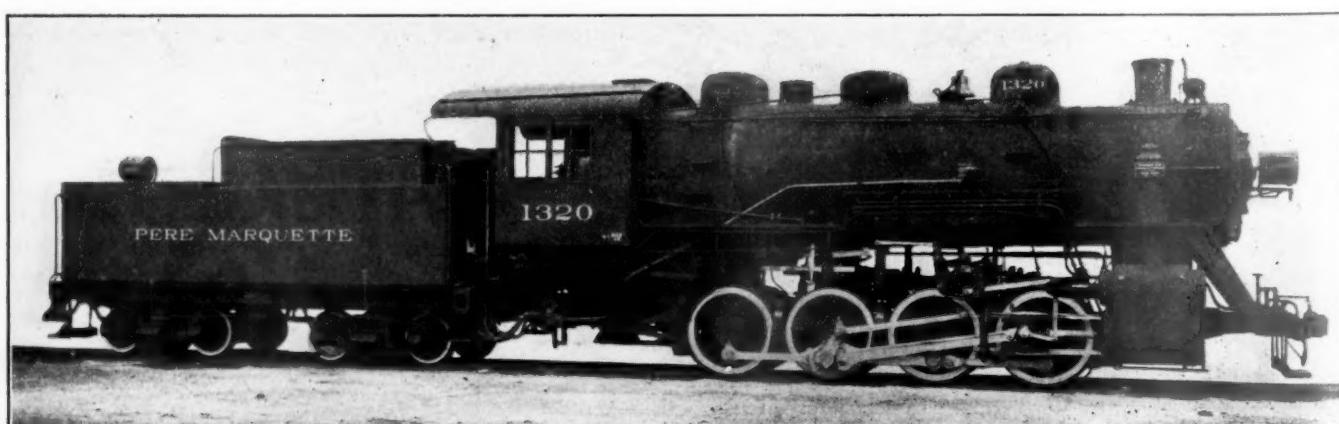
for the Mechanical Division that its conference was such a decided success in spite of the poor accommodations in this respect. Mechanical department officers, as a rule, are not qualified as public speakers; for this reason it is all the more important that the meeting room be selected with the greatest of care. The attendance will naturally grow larger and larger each year. Conditions were none too good in Convention Hall at Atlantic City. Assuming, however, that outside noises can be controlled it would seem that amplifiers of some sort—which should be tested in advance—could be installed so that the ordinary voice could be heard throughout the room. It would be necessary, probably, for each man to go forward and speak from a fixed position. This would require ample aisle space and space between the rows of chairs. Objection might be raised to these provisions, but it must be remembered that the division has grown up into a large organization and it is essential that adequate facilities be provided for the proper effective conduct of its business—this is vital to the continued growth and effectiveness of the division.

* * * *

The future of the Mechanical Division looks bright. It has held a successful and constructive meeting under serious handicaps. It has had a checkered career ever since its convention was cancelled a number of years ago when our country entered the World War. It

**Looking
Forward!**

is, however, coming back to its own. Its officers are already looking forward to next year and planning for big things. They were heartened by the sincere appreciation extended to them by General Atterbury, Sir Henry Thornton, Mr. Aishton and Mr. Markham. They appreciate the statement by Mr. Storey that "Since I have attended these meetings I have become a convert to the exhibitions and to the work that has been done." After their experiences with the weather and the poor meeting hall conditions at Chicago, it is doubtful, however, whether they will subscribe to his statement, "I believe that better results will be had here than meeting in Atlantic City." The year 1924 holds great promise for the Division.



Eight-Wheel Switching Locomotive for the Pere Marquette, Built by American Locomotive Company

Proceedings of Mechanical Division Meeting

Large and Enthusiastic Conference with Constructive Program Designed to Help Meet Increasing Traffic Demands

THE 1923 ANNUAL MEETING of the Mechanical Division, American Railway Association, was held at Orchestra Hall, Chicago, Wednesday, Thursday and Friday, June 20, 21 and 22, 1923.

The meetings were opened and called to order at 10:00 A. M. on the first day and 9:30 A. M. on the other two days. The three afternoon sessions convened at 2:00 P. M. The first floor of the Orchestra Hall was reserved exclusively for railroad representatives and members of the Division, visitors being permitted to occupy the balcony. Registration was in the lobby by special registration clerks.

Chairman Coleman's Opening Remarks

We are all very sorry that the railway conditions, after the experience we have had during the past year, did not justify a regular convention this year, but I sincerely hope



J. Coleman

that next year will offer a greater opportunity for a real convention. The Railway Supply Manufacturers' Association is very much disappointed at the postponement of your convention but is earnestly looking forward to offering you an exhibit next year showing many improvements in machinery and devices.

The program for this business meeting is somewhat different from former programs of the meetings of the Mechanical Division. We have here representatives of the executives of the American Railway Association who will address you; also two gentlemen who represent two of the largest manufacturers of railway equipment—both of these gen-

tlemen are outstanding figures in their respective lines and the papers they will offer you will be of great benefit to this association.

I want to congratulate you on this splendid attendance representing the mechanical genius of the railways all over this continent—men interested in the building, maintaining and operation of railway equipment. It shows the hearty co-operation among you men who are responsible in your particular line for the maintenance of railway equipment. It also is a compliment to the executives of the various railways of this country who encourage this co-operation and your attending meetings—your visits to railway shops and exchanging ideas with men holding similar positions, from the foremen, master car builders and general superintendents of motive power. These are the men who are responsible for the expenditure of a large percentage of the earnings of each railway in the maintenance, operation, design and building of railway equipment. These men are spenders of money, and in a way not earners because the earnings come from traffic solicited through channels of the traffic department; but you are responsible for the condition of the equipment for the movement of all transportation on the railways and the earnings depend entirely on the condition of your equipment.

There has been some reflection and some criticism on the operation of the railways through various channels—in legislatures and other organizations which are not familiar with the inside workings of railways, especially in the mechanical department.

The papers that will be presented and the reports of the various committees will be most interesting, and I sincerely hope that every man from all parts of this broad country—both United States and Canada—will give an expression to the chairmen of the various committees of their experiences in operation and maintenance of equipment. Some railways have to operate under most extreme climatic conditions during the winter months; others have an opportunity of operating under most favorable conditions, and the experience of all is necessary for the guidance of the chairmen of the various committees to prepare reports that will be educational and of benefit for the standardizing and operation of equipment all over this country.

Economy and Efficiency

The slogan of this organization is "Economy and efficiency." What you have been striving to do, and what has been done since the close of the great war, in trying to rehabilitate the railways after the experience you have had, clearly demonstrates I think in the minds of all, and in the minds of your executives, that the policy of this organization has been and always will be a progressive and constructive one.

Report of the Committee on Nominations

THE terms of office of the chairman, vice-chairman and seven members of the General Committee expire June, 1923. In accordance with action taken by the General Committee and recommended in its report to the association this year as the result of a resolution adopted at the 1922 annual meeting, the term of chairman and vice-chairman of the division is changed from two years to one year, which will make it necessary to elect both a chairman and vice-chairman of the division at the 1923 annual meeting.

In accordance with Section 7 (a) of the Rules of Order of the division which provides that officers of the division shall be elected at the regular meeting of the division held in June of each year, the Committee on Nominations nominates the following for the offices of chairman and vice-chairman:

FOR CHAIRMAN—Term expiring June, 1924:

John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe.

FOR VICE-CHAIRMAN—Term expiring June, 1924:

T. H. Goodnow, superintendent car department, Chicago & North Western.

As the terms of seven members of the General Committee expire in June, 1923, the Committee on Nominations nominates the following to serve until June, 1925, as members of the General Committee:

C. E. Fuller, superintendent motive power and machinery, Union Pacific.

H. L. Ingersoll, assistant to president, New York Central.

Willard Kells, superintendent motive power, Atlantic Coast Line.

J. S. Lentz, master car builder, Lehigh Valley.

H. C. Oviatt, general mechanical superintendent, New York, New Haven & Hartford.

J. J. Tatum, superintendent car department, Baltimore & Ohio.

W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

The committee also nominates J. Coleman for member of the General Committee to fill the unexpired term of T. H. Goodnow, who is nominated for the office of vice-chairman and whose term as member of the General Committee expires in June, 1924. The committee also nominates C. H. Temple, chief of motive power and rolling stock, Canadian Pacific, to fill the unexpired term of W. H. Winterrowd, who has left railroad service and whose term expires in June, 1924.

The report is signed by F. W. Brazier, chairman, assistant to general superintendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power and equipment, Central Railroad of New Jersey, and W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific.

Election of Officers

W. O. Thompson (N. Y. C.) reported for the election tellers as follows:

For chairman, term expiring June, 1924—John Purcell, 173 votes.

For vice-chairman, term expiring June, 1924—T. H. Goodnow, 169 votes.

For members of the General Committee, terms expiring June, 1925—C. E. Fuller, 157 votes; H. L. Ingersoll, 168 votes; Willard Kells, 140 votes; J. S. Lentz, 166 votes; H. C. Oviatt, 171 votes; J. J. Tatum, 171 votes; W. J. Tollerton, 165 votes.

For members of the General Committee, terms expiring June, 1924—J. Coleman, 168 votes; C. H. Temple, 167 votes.

Mr. Purcell: I want to thank you for the honor you have bestowed upon me in electing me chairman. I realize the responsibilities of the office together with the amount of work which is attached to it, but I feel that with your assistance we will handle the work promptly and to the entire satisfaction of all.

(The incoming chairman took the chair.)

Mr. Goodnow: I appreciate coming into office and during the tenure of office will try to do my best; you know, however, that as new men enter the ranks somebody has got to take their

places. Some of those sitting in the rear have got to move forward and help out.

As chairman of the Committee on Committees, if I continue in that capacity this year, I hope we can get some new blood into the committees—it is awfully hard for the committees when you know individuals here and there but don't know how active they may be; if you want a job, just send your name to me and I will see that you get it. I am serious in that question; we want you to get a new enthusiasm; we want to get some good timber.

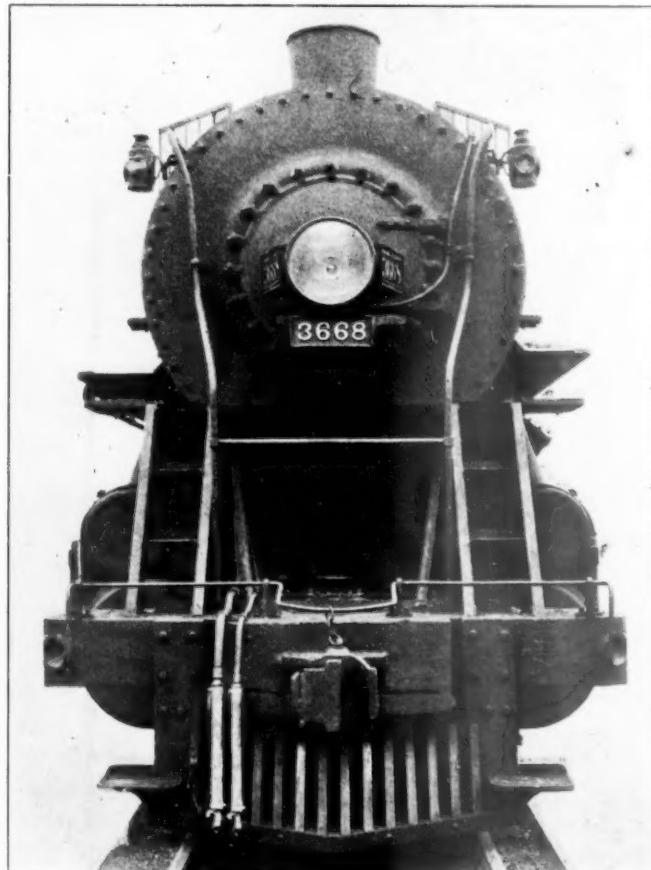
Appreciation to Past-Chairman Coleman

A rising vote of thanks was given the retiring chairman, Mr. Coleman, for the very efficient manner in which he handled the affairs of the association during the past year.

C. F. Giles (L. & N.): I want to refer back to the remarks of Mr. Goodnow on the subject of the younger members of this association taking more interest in the affairs of the association as well as participating in the discussions during the convention. That has been a subject of discussion with the members of the General Committee for several years, especially after the last meeting in Atlantic City in 1922, when it was apparent that very few of the members on the floor took very much interest, or participated in the discussion.

Now, I am delighted to observe during this meeting that there has certainly been a wonderful improvement in that respect.

Speaking of Mr. Goodnow, I have been working with him now for about 11 years as a member of the General Committee and on other committees, and whoever steps into his shoes as a member of any of these committees to take up the work that he is compelled to lay down, partially at least, has got to go some. He has been one of the best and most untiring workers that we have in the association, and it has been a question of the willing horse.



Front View of S. P. 2-10-2

Founders of Master Car Builders' Association

It is Doubtful If the Wonderful Record of Achievement of the M. C. B. Can Be Equalled

By F. W. Brazier
New York Central

I DESIRE to take but a few moments of your time briefly to review what this association has accomplished in its existence of over 50 years and the debt we owe to the old master car builders of the different railroads of this country and Canada, who laid the foundation upon which this association has stood all these years. Like a solid rock, it stands today the leading mechanical association of the world. Its rules of interchange which govern the movement of practically all the passenger and freight equipment in the United States, Canada and Mexico are binding on every subscribing company and are the means by which the interchange of cars is expedited and serious delays reduced to a minimum.

A Record of Accomplishment

It is a legislative body that makes rules and adopts standards which must be lived up to by every road and private car line operating cars for interchange. It was the old master car builders who got together, years ago, and foresaw the need of having standard parts of cars made uniform so as to reduce the number to as few as possible, thereby reducing the stock necessary to carry in order to promptly make repairs. For illustration to show how this was brought about:

In 1882 we had 56 kinds of axles, which in 1918 was reduced to.....	5
In 1882 we had 58 kinds of journal boxes, which in 1918 was reduced to.....	5
In 1882 we had 26 kinds of couplers, which in 1918 was reduced to....	2
In 1882 we had 27 kinds of brakeheads, which in 1918 was reduced to..	1
In 1882 we had 20 kinds of brake shoes, which in 1918 was reduced to ..	1

Total..... 187 Reduced to..... 14

The safety appliance standards with which cars are today equipped, are the result of the efforts of these old master car builders. The federal government recognized the benefits to be derived through the adoption of these safety standards and the Safety Appliance Law was accordingly enacted.

What greater compliment can be paid to the old master car builders than that not only the federal laws on safety appliances are the result of their achievement in voluntarily making the cars safe for trainmen, but that all the great insurance companies take the M. C. B. Rules as a basis for settling all claims for fire damage to equipment.

During the last few years, conditions have arisen which resulted in the taking away of the title of "Master Car Builder" on some roads but the work is going on just the same, only under the supervision of a man with a different title.

There are a number of different associations doing fine work in their line, namely, the Travelling Engineers, Master Blacksmiths, Storekeepers, General Foremen, Painters, Master Boiler-makers, Electricians, Air Brake Men and others who hold conventions where papers are read, treating on matters having an educational value to their members; the information gained cannot help but be the means of getting better results. A man who attends these meetings should become a student of his work.

Educational Value of Exhibits

In the past we have had at our conventions wonderful displays of up-to-date machinery, tools and parts of cars and locomotives. Locomotives and machinery have been shown in actual operation. These exhibits, without doubt, had a wonderful educational value for the shop forces and gave them new thoughts and ideas which would be put into practice upon their return home and thereby be the means of effecting permanent and substantial economies in operating cost which, under present operating conditions, is something not to be passed over lightly.

Today, the man who succeeds is the man who studies his line of work and keeps in touch with what is going on outside his own door. We have some splendid railway magazines which portray to us the latest railroad news so there is no excuse for

anyone seeking information not finding it if he really wants it.

Would to God that today with all the unrest in this country—brought about largely by self-seeking political radicals preaching government ownership, the Plumb Plan, etc. (which means plums for the advocates and politicians)—that we could have a Lincoln that would rise up and lead the people into the right pathway that would bring about peace, contentment and prosperity to all the railroads of the country. The old master car builders were eminently successful in their line of work. Why? Because there were fewer politicians or factions to please. They worked for the good of the cause and the public received the benefit.

Pioneers of M. C. B. Association

In looking over the pioneers of this association, we find a long list of able men who, in their day, assisted in laying its foundation and are in a large measure responsible for its success. Today we have only 10 men left who have been in active service in excess of 30 years as members of this association, (I mean the old master car builders) and I desire to mention a few.

One—a past-president, is the oldest member in active service, has been a member for 45 years, has been in the service of his railroad for 38 years and is a member of our General Committee. I refer to our past-president, John S. Lentz, of the Lehigh Valley.

I also want to mention another past-president who has served his company over 50 years, been a member here over 33 years and is yet in service; a man who has been one of the leading master car builders of the country—John J. Hennessey, of the Chicago, Milwaukee & St. Paul.

We also have our retiring chairman, who has been a member 33 years, who has worked faithfully in his position to represent the Canadian railroads and has greatly helped to keep the standards of this association the same in Canada as in the United States—a wonderful record.

The other names on the list I desire to mention are George Rommel, Samuel Porcher, J. B. Michael, D. B. Middagh, J. Doyle, W. D. Holland and F. W. Brazier.

Presentation to Retiring Chairman

Mr. Coleman; the officers and members of this association desire to express to you their appreciation of the manner in which you have presided at its meetings and the personal interest you have manifested in all its affairs. Your name will now be added to the list of past-presidents as one, whom, we of the Master Car Builders' Association all honor. I have had the pleasure of your acquaintance for over 30 years; we have worked and played together and I know you as a friend and as one of our leading master car builders. Upon me has been conferred the very great honor of presenting to you, this past-chairman's badge and in so doing I feel highly complimented. May you wear it and feel that it carries with it the earnest wish of each one that your pathway may be strewn with flowers and your life be one of contentment, health and happiness.

Chairman Coleman: Permit me to express my appreciation. I am thankful that our friend Mr. Brazier didn't say some things about me that he knows; he said good things; this is a time in life when you like to hear good things—while you are living; sometimes you hear the bad things while you are living but have got to die before the good ones are said.

I want to thank you sincerely for this tribute that I will always remember; I hope to be able to wear this badge for many years to come when I come here and assemble with a family of the greatest mechanical geniuses in the world. You are recognized all over the world as the leader in your line of work. It is a compliment, and a big one too, to be selected among a family of friends like this to preside at your meeting and I do sincerely thank you from the bottom of my heart.

Appreciation for the Mechanical Department*

Remarkable Record Has Been Made in Spite of Most Serious Difficulties and Handicaps

By W. W. Atterbury

Vice-President, Pennsylvania Railroad System

LET ME SAY at the outset that the Mechanical Division—the men responsible for the condition of cars and locomotives with which to move the country's freight—cannot be given too much credit for what they have accomplished in recent years in the face of almost insurmountable difficulties.

Frankly, I do not think that railroad men in general, much less the public, have an adequate conception of the handicaps which the motive power men have overcome. I cannot begin to summarize in a letter what the past eight or ten years have meant in difficulties, disappointments, hard work, and determination in the mechanical departments of the railroads. I know of no finer tribute to their zeal and energetic devotion to the public service than the reports which are now coming from the Car Service Division in Washington. Only a few days ago a batch of newspaper clippings were placed on my desk, with headlines something like this: "Rail Motive Power in Record Condition—Greatest Number of Serviceable Locomotives Available in History of Transportation."

Labor Problem

Greatest Difficulty

These, of course, do not begin to tell the story as we know it. We who do know it, however, can read between the lines not only congratulations to the mechanical men, but also a guarantee that no matter how much more remains to be done, these men will get it done.

What happened to the mechanical forces during and since the war is familiar to those directly in charge. The labor problem was, beyond question, and in some respects it is today, the greatest difficulty. Even prior to the war most of us did not have sufficient funds with which to make necessary improvements. Most of us have not had sufficient funds since then. That condition, however, was aggravated by much more serious developments in the relationship between managements and employees on all railroads in the country.

Anti-Railroad Propaganda

The scale of rates of wages built up through years of practical experience was shattered, piece-work was abolished, classification of mechanical work in the shops was rearranged on an unsound basis, featherbed jobs were forced upon us, and overtime and pay for time not worked at all added to already mounting costs of production. On top of that came outside dictation as to methods and practices and pay and every conceivable thing to make the work in the motive power

*Vice-President Atterbury was unable to attend the convention, but sent this message through President Aishton, of the American Railway Association.

department an exceedingly thankless and an altogether unsatisfactory job.

Much Accomplished Under Difficulties

I mention these things merely to emphasize my own realization of what the Mechanical Division men have encountered, in contrast to what they have, nevertheless, accomplished. In expressing the appreciation that I believe

is their due, I might also refer to another handicap which is still upon us. In the past five or six years the railroads have been subject to a constant attack of anti-railroad propaganda, fostered in large part by representatives of railroad employees—of employees especially in the mechanical department. The result has been two-fold: It has not only affected the morale of the men themselves, but also has resulted in a flood of restrictive measures which have seriously affected the output of the shops.

Transportation Program of the A. R. A.

When you consider all these difficulties on the one hand, and on the other the remarkable progress that has been made since the war, in spite of extraordinarily heavy business and the coal and railroad strikes, I am frank to say that every mechanical man should now be a confirmed optimist. The program of adequate transportation which the American Railway Association has laid out should give them

no pause. Of course, to carry it out requires practically one hundred per cent performance on their part, but if they put as much energy into it—under the better present conditions than they have had for many years—as they put into their jobs during and since the war, it ought to be for them a comparatively simple task. Therefore, I do not hesitate to add that the carrying out of that program depends more upon them than any other branch of the service.

Employee Representation

As to the general situation, you, of course, know my attitude as to the proper relation between railroad management and railroad employees. The policy of dealing directly with our employees through their own employee representatives is no longer an experiment with us. It is a working success. In the past few days that policy has been extended even to the adjustment of piece-work prices by conferences equally representative of management and employees, with two-thirds vote deciding any issue. I believe that if the railroads can get their relations with their employees on the basis of facts, fair play, and faith in each other, a great deal of our troubles will end.

Railroads Are Giving a Remarkable Service

Additional Big Demand to Come This Summer—
Co-operation Needed from Every Employee

By R. H. Aishton

President, American Railway Association

IT IS A VERY GREAT PLEASURE to meet you all here today, the Fourth Annual Meeting of the Mechanical Division; and, believe me, for a four-year old you are a mighty lusty lot. However, when we consider that while you are only four years old as a division of the American Railway Association, this meeting represents the fifty-sixth annual meeting of the Master Car Builders' Association and the fifty-fifth of the Master Mechanics', then after all if age gives wisdom you are to be congratulated. You have mighty good reason to be proud of what your two constituent associations, now merged, have accomplished in the more than half-century of their existence in bringing about

Standardization

Interchange Rules

Loading Rules

Development of Better Methods

Dissemination of Information as
to Better Practices

And through it all there has not only been the greatest co-ordination as between the railroads, but it is also peculiar to the railroad business, as in no other business, that there has been the most complete co-ordination and co-operation with equipment builders and governmental authorities, some of the results of which are going to be shown to you at this meeting—from a locomotive standpoint by Mr. Vauclain, and from the equipment standpoint by Mr. Carry.

While the record is one of which you railway officers and equipment

builders may justly be proud, and the development has been one in which you have had a very large part, there is still a direct obligation before you all in furthering development both of machines and of methods whereby the railroads may be enabled to function more economically and efficiently. There is as much room for the exercise of initiative today as there was in the days of the "Stourbridge Lion" and you gentlemen of the railroads and of the manufacturers are the people to whom the American people are looking and to whom the government is looking to develop and bring about improved methods.

The importance of this meeting at this time is great. There never has been a period when the people were so interested in what the railroads are doing to better conditions than now; neither was there ever a time when the people as a whole understood the problems of the railways more thoroughly. Every officer of a railroad here I hope will feel that he has a personal interest in this subject and if he has any ideas—whether they correspond with what the committees in their wisdom have developed or not—he will not hesitate to get on this floor and express them, because when a committee has thrashed over one of these subjects and

when you have agreed that that is the proper thing to do, it ought to be about the last word as to whether it is a correct thing to do or not; and another thing, when you have once made up your mind and voted that it is the thing to do don't go home and forget all about it; tell your people why you think as you do and why it is a good thing; in other words, sell yourself and your proposition and do not hide it under a bushel, or trust to Hawthorne or me to sell it for you.

There has been criticism about meetings taking up men's time and that after all the findings are not mandatory and they don't become standard to as great a degree as they ought to. Why not? You have got the answer right in your hands—it is up to you.

A Remarkable Achievement

Now a word about the general situation in which you are all individually very much interested. Standing on the side lines as I have in the past year there is full opportunity to observe matters. I want to make the statement, without any hesitation, that the railways of the United States during the last year have individually and collectively made the finest record of efficient operation that has ever been made in their history or the history of any railway systems in the world. Railway management, ever since private operation was resumed three years ago, has been subjected to constant and bitter criticism and attack from various sources and upon vari-

ous grounds. The best answer to these criticisms that can possibly be made is the record of achievement which the railways have put to their credit within the last 12 months.

Just one year ago at this time the country was in the midst of a strike of miners in the coal fields, which had entirely stopped the production of anthracite coal and had practically stopped the production of bituminous coal, except in a comparatively small territory. It was threatened, on account of this strike, with a serious coal shortage. As if that was not to disarrange the business of the country, almost exactly a year ago the employees in the shops of the railroads throughout the country went on a strike against a reduction in their wages ordered by the United States Railroad Labor Board. At that time there already had begun a revival of the general business activity and one of the largest sudden increases in railway traffic in the country's history.

As a result of these two conditions, and when the coal strike terminated about September 1 last year, the demand for the movement and transportation of coal suddenly became abnormally large and at the same time the demands for transportation of other commodities assumed abnormal proportions, creating probably the most difficult transportation



R. H. Aishton

problem in the history of any system of railways in the world. In a few weeks a large freight car surplus suddenly became a car shortage, which in October reached the record-breaking figure of 179,000 cars. At that time, owing to the shop employees' strike and other conditions, the railway had about 16,000 or approximately 25 per cent of their locomotives in bad order, and almost 300,000, or about 13 per cent, of their freight cars in bad order.

The first problem the railways had to contend with was to prevent a serious coal shortage and consequent intense suffering during the winter months. Although coal mining had been largely suspended for almost six months, and although, owing to the increase in general business activity there was a large increase in the demand for coal, they handled the output of the mines so there were only temporary and sporadic shortages of coal. During the first 130 working days of the present year they moved over 231,000,000 tons of bituminous coal, which was the largest amount ever transported in the same part of any year, except the war year of 1918, and until the demand for coal began to slacken as spring advanced they were moving more coal than even in 1918.

In addition to the movement of this coal during the last nine months, the railroads have handled a larger total freight business than in the corresponding months of any previous period in history. From January 1 to June 2 they loaded and moved 2,147,000 more carloads of freight, or over 12 per cent, than in the same period of any previous year. The largest freight movement usually comes in October, but in the week ended May 26 the total cars loaded exceeded 1,014,000 cars, which has been exceeded in only two weeks in the fall of previous years.

I have just received by wire figures for the revenue loading for the week ended June 9, which show a loading of 1,013,249 cars of revenue freight, which is an increase of 176,621 cars over the corresponding week of 1922.

Although handling the largest business in history, they have steadily reduced the "car shortage" until in the week ended May 31 there was actually a small surplus.

Getting Ready for Future Demands

So much for what has been done. What is the job that lays ahead of you? As you know, there is always in periods of active business a very large demand in the summer months for box car to move the crops of the western states. In spite of the record-breaking traffic thus far this year, rapid and satisfactory progress has been made in moving empty box cars from the eastern to the western roads for the movement of crops. This movement of box cars westward was begun early in the spring and is still in progress and it is confidently believed that sufficient cars will be available in the western agricultural sections to meet all the demands that will be made this summer and fall. There are actually today on hand sufficient grain cars stored to handle the crops.

From April 16 to June 8 more than 46,000 empty box cars were delivered in Chicago and St. Louis to western roads by eastern and southern lines. This movement to the west was made at the same time that a very heavy movement was being made from the states to Canada of box cars of states ownership and the return of Canadian-owned cars in anticipation of the Canadian grain movement. The number of cars sent westward through Chicago and St. Louis to be ready for the grain movement has been close to 1,000 daily. Ample cars have been provided for moving the peach crop from Georgia and cantaloupes from California.

What other provisions have been made in anticipation of further increases in traffic? In order to handle the increased freight traffic anticipated this year, the railroads from January 1 to June 1 put in service 65,660 new freight cars and during the same months put in service 1,697 new locomotives. In addition, on June 1 the railroads had on order 107,079 new freight cars and 2,041 new locomotives. Both the equipment manufacturers and the railroads are making every effort within their power to secure the earliest possible delivery.

At a meeting in New York early in April the railroad executives adopted a comprehensive program for providing the country with adequate transportation service. You are familiar through your individual managements with its requirements. It provides for reducing the number of cars awaiting repairs to 5 per cent by October 1 and for reducing the locomotives awaiting repairs to 15 per cent by that date. It also provides for the better loading of cars, for better movement of cars, for storing coal, and for all the various things which you are fully acquainted with which will enable the meeting of the peak load of the country's transportation.

Substantial progress has been made on the fulfillment of this program. The number of freight cars awaiting repairs had been reduced on May 15, as against August 1 last year, by 135,000, and while possibly 50,000 of these may be attributable to retirements, nevertheless it does show material progress. Locomotives in bad order between September 1, 1922 and May 15, 1923, have been reduced by 4,400.

The record of efficiency already made in the face of the great difficulties of the past year is the best answer that can be offered to the criticisms that have been made of the railways and to the demands for radical legislation that are being made on the ground that such legislation is needed in the public interest. It is my firm belief that an even better record will be made during the rest of the year in serving the public and that as a consequence thereof the public will be firm in the belief that it is to its best interest to give the railway managements a chance to serve it efficiently rather than to hamper them by restrictive legislation.

One thing, however, I do want to impress upon you in relation to this program. You have about four months left in which to meet its requirements. You, no doubt, have your instructions from the individual managements of each individual railway as to your own individual treatment of the program. Whatever your instructions may be, see that those instructions are thoroughly understood by every employee and officer that has any part to take in the fulfillment thereof, because the complete fulfillment of this program and the service that the railways are consequently able to give the public can only be accomplished through a complete understanding of the officers and employees directly charged with carrying out the work, of its importance and its effect in meeting the demands for transportation to the full satisfaction of the American people, whose servants you are and on whose final judgment, which will be largely influenced by the measure of service afforded, the future of these great transportation organizations rests.

An Appreciation

Now, gentlemen, in conclusion I want to express on behalf of the board of directors the great appreciation of the executives, individually and collectively as an association, for the untiring efforts that have been put forth by the Mechanical Division to meet these various problems.

There never has been a time that we have had to appear before the Interstate Commerce Commission or before a congressional committee or before anybody else about some phase of this question—and the times have been mighty frequent in the last twelve months—that questions to your chairman, Mr. Coleman, have not brought an instant response—the formation of a committee. Those committees have gone to Washington at the expense of fatigue, and annoyance, and time, and thought and all that kind of thing, and those special committees, your regular committees, your general committee, your secretary, Mr. Hawthorne, and your chairman Mr. Coleman, have done a wonderful work on behalf of your association this year. I would feel remiss in my duty if I did not express to all of you gentlemen the appreciation of the executives for the good work you have done.

The Work of the Mechanical Department

Committee Work Reviewed—Mechanical Department an Essential Cog in the Transportation Machine

By W. B. Storey

President, Atchison, Topeka & Santa Fe, and Member Board of Directors of the A. R. A.

WHEN THE PRESIDENT of the American Railway Association asked me to make some remarks here today he said: "You must remember, Storey, the Mechanical Division is your baby." Rather a good-sized baby, and possibly some of you may wish to know why it is my baby.

When the reorganization was effected by which the various associations connected with railroads were brought under one control—that is, the American Railway Association—it was decided that a member of the board of directors of the American Railway Association should be assigned to each division. For instance, one of the directors is assigned to keep in touch with the work of the Claims Division; another one, the Engineering Division; I was assigned to the Mechanical Division.

As a consequence I have attended practically all of the meetings of the General Committee and have familiarized myself with the work that has been done by the Mechanical Division during the time I have been assigned to that work and therefrom I have drawn certain conclusions, and I am going to submit them to you today.

For many years you comprised two organizations—the Master Car Builders' and the Master Mechanics'. Most of the motive power officials were members of both associations. When the reorganization took place, by which the Mechanical Division was formed, many of you felt that the passing of the old organizations meant the end of the work in which you had all become so interested, and you accepted the new order of things with some question as to whether it would really fill the place so long held by the original bodies—and with some it has been hard to feel as much interested in the present plan as in the old. One of the tasks before you, therefore, is to restore the morale which actuated you so strongly in the old days.

Valuable Work Accomplished by Some Committees

There is, of course, no question as to the work that is being accomplished by some committees, but there are many directions in which nothing is being done. Let us, therefore, take a quick review of your various committees. Those that are on the list of what I might call active committees are the Arbitration, Prices for Labor and Materials, Car Construction, Couplers and Draft Gear, Brakes and Brake Equipment, Train Brake and Signal Equipment, Wheels, Loading Rules, Safety Appliances, Locomotive and Car Lighting, and finally the special committee on Tank Cars. All these committees are very much alive and doing very valuable work—I might say, that this is work which is ab-

solutely essential to the every day handling of interchange.

Then there are the inactive committees, if I may so style them, viz., Autogenous and Electric Welding, Feed Water Heaters for Locomotives, Mechanical Stokers, and Electric Rolling Stock. While the work of these committees may be classed as not of first importance so far as interchange of cars is concerned, it is highly important from an economic point of view and much could be accomplished if this work was actively pushed. The cost of the committee work should not be heavy and much can be accomplished for the common good.

Common Experimental Laboratory Needed

There is one committee that can hardly do much until the railroads as a whole are willing to support a physical laboratory; viz., Locomotive Design and Construction. There is no question as to the importance of these subjects to the different railroads, but each individual railroad has thus far worked out its own problems and has been compelled to do its own experimenting. There is, of course, not the need for standardization as in the case of cars, because locomotives do not pass from one road to another; but if an experimental plant could be supported by the railroads as a whole, I feel that great good could be accomplished by this committee.

There is another committee that may be of some value, but it has a subject that is hard to standardize.

I speak of Scheduling of Equipment Through Repair Shops. Such studies must be made by each road and must hinge on the design and capacity of each shop.

Follow-up Work Essential

It is my feeling that to place the Mechanical Division where it belongs, live energetic work must be done by practically all our committees. We have been going through a transition period and, with the many problems facing us when the roads came back to us, with our shopmen's strike, with our heavy business one year and our famine the next, we have all been so busy taking care of the immediate problems confronting us and we have been so circumscribed by the orders for economy, which means on many roads the cessation of expenditures, that we have not been able to take that larger view necessary to a proper understanding of where the real economics can be found. I say to you, gentlemen, that the real economics are in the results of your committee work, but this work must be systematically planned and advanced. It does not answer simply to appoint a committee and say, "Now that question is settled." The plan must be systematically followed up, and you must have an organization that will so manage that chairmen of committees



W. B. Storey

that do not produce will be replaced by those who will get results; and members of committees who do not take any interest in their subject will be replaced by those who will work. In this way only will you prevent dry rot creeping into the Mechanical Division.

Mechanical Officers Carry Heavy Responsibilities

I think you all recognize the tremendously important part you play in the general plan of railroad transportation, but I sometimes doubt if our executives, as a class, realize it. On the Santa Fe Railroad last year practically 30 per cent of our entire expenditure for the year went to maintenance of equipment—or nearly one-third of the entire expenditures of the road. The proportions on one road are representative of the country as a whole, and you can thus see what a tremendous responsibility rests on you. It is because of this large interest that lies in the mechanical end of our work that the Santa Fe for one is ready to back any program that makes for economy. I therefore ask you to take yourselves seriously and to strive to make the Mechanical Division the live force that it should be.

Mechanical Department Should Work Smoothly with Other Cogs in the Transportation Machine

Next, I wish to say a few words to the younger men here today—the older officers know of what I am about to speak, but the younger officers may not have had the subject brought to their attention. I refer to the relation between the mechanical department of your road and the balance of the working forces. Too often we have the feeling that the mechanical department is so far removed from the public that we have no interest in the relations with that great and powerful force, public opinion. First, however, we must realize that we are an essential part of the transportation machine; that while we may be only a cog in that machine, we are such an important cog that the machine would be worthless without us—and, as a cog works with other cogs, so must we of the mechanical departments work with the operating and maintenance-of-way departments. We must take an interest in the work of others—in other words, we must have team work—so that all departments will work together for the good of the whole. You of course have most intimate relations with the transportation department, because it lays at your doors all delays to trains due to failure of equipment, and you are compelled to spend much time in telling why. The transportation department is another cog, and it has its troubles as well as the mechanical department—and I think you have sympathy for each other. But what about the maintenance of way and structures department? You do not come in as close contact with them and they seem to be a world apart. They, however, are a cog and deserve your very close attention. In this connection, I wish to call attention to the report, just out, of the committee

on wheels. In this report is given the record of a joint meeting at which there was a full discussion of the tread design of wheels and its relation to the canting of rails. All such discussions are good for the service.

Then comes the engineering department with its endeavor to limit the weights on drivers and its inability to get turntables long enough or roundhouse doors wide enough to handle properly your engines.

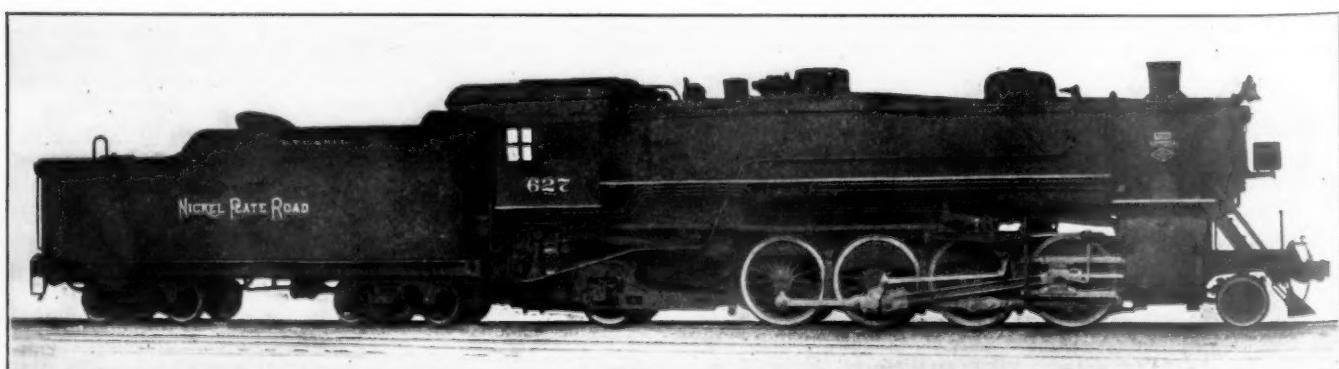
I suppose many of you hardly can see any intimate relationship between the accounting department and the mechanical department. You know, of course, that such a department exists, but its connection with you and your work has, as a rule, been a bothersome one only. I want to say right here that the mechanical department needs the accounting department, and the more you cultivate it and study it the more good you can get out of it. If you men in charge of work could take a short course in auditing and accounting, it would help you immensely. You cannot learn how to save unless you learn to think in terms of cost, and the business of the accounting department is to determine costs. And so it is with all departments—you must work with them; therefore, help them all you can and learn from them all you can.

Relation of Mechanical Men to the Public

Finally, I wish to speak of the relation of the mechanical man to the public. Much of the trouble that has come to the railroads in times past has been because the public did not understand the railroad question. The way to make them see it is to understand it yourselves and to have your foremen and the men under the foremen understand it; and if they understand it, they will have a very strong influence in getting the public to understand it. We want your help in spreading the gospel. Tell your neighbors that what we want is a moratorium—we want to be let alone for a time to see if we can work our way out of the many difficulties that beset us. Tell this to your neighbors. You come in contact with part of the public and you can help to that extent, and in this helping you are enhancing the value of the mechanical department.

A Mechanical Division Booster

In closing I want to say that I am heartily in sympathy with this idea of meeting in Chicago. Before I became attached to the Mechanical Division I had some doubts about our meetings in Atlantic City, but since I have attended these meetings I have become a convert to the exhibitions and to the work that has been done and I believe that Chicago is the more central point and that we can concentrate our work more here and I believe that better results will be had here than meeting in Atlantic City. I simply wish to give you that as my private opinion that I have formed after an observation of the work of the Mechanical Division during the time that I have been attached to it.



Mikado Locomotive for Nickel Plate, Built by Lima Locomotive Works

How Employees Can Help With Public Relations

They Have Everything at Stake—An Apt Illustration from the Free Silver Campaign

By C. H. Markham
President, Illinois Central

YOU HAVE HAD others here very much better qualified to talk to you about the important matters with which this meeting is concerned. I was very much impressed, for example, with the statements made to you by Mr. Aishton yesterday showing what the railroads have accomplished in the very distressing and difficult times following the coal and shopmen's strikes last year.

It was also illuminating to note his statement of the progress that is now being made in getting ready for the difficult task of handling the peak load of traffic which we are going to be called upon to carry next fall. No one appreciates more than I do the importance of the work of the mechanical men of the railroads of this country.

Provision of Proper Tools

No one appreciates more than I do the importance of providing the men in the mechanical departments of the railroads of the country with the proper tools to work with, and when I use the word "tools" I by no means confine myself to the consideration of the question of the adequacy of the shop tools. I mean more than that—the consideration of all of the elements that enter into the successful operation of our American railroads. It is not only the tools themselves—the shop buildings, the quantity and the quality of the power furnished, but last, and not least, a proper and good relationship with all of the people of this country. This last is necessary in order that the railroads may receive at the hands of those who have to do with creating the conditions under which we operate that which will enable those of us who have to do with financial matters—always involved in that important question of furnishing the necessary tools to work with—to obtain a sufficient return from the operation of these properties to secure from time to time the new money necessary to provide you with the tools which you must have for the operation, if the operation of the railroads of this country is to be successful.

I do not believe there has ever been a time, certainly not within my knowledge in the history of American railroad ing, when there was as good an understanding on the part of the public of the needs of our railroads as exists today.

How the Employees Can Help

I want to discuss with you for a few moments, if I may, the importance of our all doing everything that can be done to improve upon and promote as best we may a continuation of that good understanding. Out of my personal experience I know what can be accomplished in the matter of car and locomotive movement—miles per day, or loading, or whatever

it may be—if the active interest of as nearly 100 per cent as it is possible to obtain of all of the employees who have to do with the handling of cars and locomotives can be obtained; when every man gives to every movement of a car or locomotive, or to every item of the handling, his individual attention to the end that every individual car and every individual locomotive is treated as a unit by itself. I know what can be obtained on a railroad when the management has been successful in obtaining anything like 100 per cent of success in the effort to develop that sort of attention.

Now if that is true when it comes to the matter of dealing with the inanimate cars and locomotives, how much more is it true when it comes to the question of each individual striving as best he may in his contact with other individuals to promote a better understanding of the railroad question. I do not recall the figures as to the number of railroad officers in the employ of the railroads of this country, but I do recall that the last statement of the number of employees showed figures approximating 1,800,000.

Suppose that we could by precept and example—each officer doing what he could to make some contribution towards the development of a better understanding of our railroad problem—get as many of the rank-and-file of the employees interested in doing what they could to make some sort of a desirable contribution toward that effort—

think of what it would mean! Many of you here are old enough to remember the Bryan free silver campaign of 1894. You will recall that it was said that if the election had been held two months before the date on which it was held, the chances were more than even that Mr. Bryan would have been elected. But now what happened? Through the dissemination of information as to what the effect of the election of a president of the United States on a free silver platform would have on the individual fortunes of the voters of this country, when election time came an entirely different result was recorded.

I remember that at that time all of my previous experience had been in silver countries—railroading in New Mexico, in Arizona, in Nevada, and later on in California. I remember that one day it dawned on me, at the time when I was advocating this fetish of free coinage of silver in the ratio of 16 to 1, that if that thing ever came to pass, when I went to the pay car and got my money the day after Mr. Bryan was elected the dollar I got would only be worth 50 cents. When that fact did dawn on me I turned out the next day, you can bet your life, and began to work from that day on for the election of Mr. McKinley.



Underwood & Underwood

C. H. Markham

That sort of thing occurred all over the country. There is no reason why it should not occur in this country on this transportation question and no one can make a better and more worth-while contribution to that end than can the railroad officers of this country.

Better, Not Cheaper, Transportation

One of the things that we of the Illinois Central—in our efforts to promote this better understanding as between the railroads and the public—are preaching is that what we want is better transportation and not cheap transportation; that the cheap transportation which does not leave the railroads of the country in a position at all times to take reasonable care of the peak load of traffic offered is in the end the dearest kind of transportation, and that no reduction in rates that would wreck the railroads would be worth-while. On the contrary, it would be one of the worst calamities that could befall the people of this country.

Again, if our rates were reduced, what would happen? When I say "reduced," I mean reduced beyond the point where we could pay operating expenses, render the service that the public wants to have us render, and at the same time get enough out of the operation to make some part of the improvements out of earnings; last, but not least, that we might from time to time be able to secure the new sum of money necessary to carry out programs of continued improvement. Any reduction in rates beyond the point where we can accomplish those things would mean ruin to the railroads of this country and in the end bring about conditions that would be nothing less than a catastrophe to all the people of the country.

What we ought to preach to people on this railroad question is the policy of not dealing with it as they see it today, but always remembering that there must be a stability about railroad rates and railroad practices that does not and cannot obtain in the handling of the affairs of any other industry. When hard times come industrial plants shut down, only leaving a modicum of the expense in the way of overhead. But a railroad can't stop. You can't leave your cars of freight standing on the side track; freight on the platforms; passengers waiting for trains to come. We have got to continue operating in good weather and bad.

It is not possible to adopt with regard to railroad rates the same policies that obtain with regard to the prices of commodities generally. For example, when hard times come, when the railroads can least stand a reduction in rates, that is the time that the great demand for reductions comes. Just now we hear scarcely anything about reduced rates except from certain professional men in public life—I almost started to call them politicians, but I am trying to get away from that habit—whose stock in trade is the creation of antagonism between the people that have and the people that have not.

You don't hear today, for example, from any section of the country, a demand for wholesale reduction in rates. When you talk to shippers today their concern is as to whether or not we are going to be able to take care of their traffic when the peak load offers this fall.

And so I say there is that difference between our situation and that of the other industries. The shipper wants a reduction in rates at a time when we can least afford it. We cannot afford to make reductions when the times are good because if we do, when business falls off later on the rates will not be sufficient to come anyway near meeting our requirements.

An Appeal to Every Employee

I want to close by an appeal to you—each and every individual officer and employee of the railroads of this country—constantly and persistently to do what you can to bring about a better understanding of this railroad question.

Remember that our representatives in Washington are

there for the purpose, at least from their point of view, of serving their constituents. Unless there is some great moral question involved where the mob spirit perhaps might rule and where the majority would not be reflective of the real views of the right thinking people of any section of the country, your representative in Congress is nearly always guided by what he conceives to be the consensus of home opinion.

Now, if, through contact, personal or otherwise; through the proper use of the advertising columns of the newspapers; through addresses made at various gatherings throughout the country, we can promote a better understanding of this railroad question at home, is it not reasonable to suppose that in time that message will reach Washington?

Perhaps I can illustrate the point better by telling you a story which I have used on these occasions with some frequency, a story of the old populist days, when it was told that a senator from a western state was talking to a friend in Washington about a letter he had received from his son concerning the growth of populism in his state. He remarked he was going back home and look into the matter.

His friend said to him: "Well, I suppose if you find the conditions as bad as your son reports you are going back there and fight these fellows?"

He said: "Hell no, if they are as strong as my son's letter represents them to be I am going back there and join them." (Laughter)

In a way that story does illustrate the situation. We all go along, broadly speaking, with a consensus of opinion of those in whom we have confidence, and our people in Washington are no different, and so I leave with you the message that if every railroad man in the country will do his part toward promoting this better understanding—and the Lord knows there is enough literature issued on the subject already within the past year to enable us all to post ourselves on any of the questions pertaining to the existing railroad problem—I haven't any doubt but that in the end we can look for fair treatment at the hands of those who have to do with the future of the railroads and that all this threat of government ownership and the evils that go with it will have disappeared.

Mr. Bentley: Before Mr. Markham leaves the hall, I wish to propose a very hearty vote of thanks for the illuminating address that he has given us and I hope that the members will arise so that he may know that we appreciate what he has done. (A rising vote of thanks was tendered Mr. Markham).



A Gasoline Rail Motor Car on the Kent & East Sussex (England)

Report of the General Committee

Outlining Action Taken Since the Previous Annual Meeting on Matters Referred to the Division

THE MEMBERSHIP of the division at the present time includes 214 railways, representing 400 memberships in the American Railway Association, and in addition thereto, 152 railroads, associate members of the American Railway Association.

The railroads, members and associate members of the American Railway Association, have appointed 834 representatives in the Mechanical Division.

In addition there are 1482 affiliated members and 106 life members in the division.

The last session of the division was held June 14-21, 1922. Since that time the General Committee has taken on several important subjects. This action is outlined in the following report and the approval of the division is requested.

Proceedings of the 1922 Annual Meeting

The proceedings of the 1922 annual meeting, together with action taken by the division during the year 1921, when no annual meeting was held, has been printed and distributed to the members.

Annual Meeting 1923

On account of the unusual conditions prevailing during the past years it was considered best to hold a strictly business meeting this year without exhibits of railway machinery and devices. The committee has arranged this three day business session of the division and has provided a program which should result in great benefit to the member roads.

Letter Ballots 1922

Recommendations from committees received at the 1922 annual meeting and ordered submitted to letter ballot of the members were sent to the members in a separate circular containing the recommendation from each committee and the result announced by a circular to the members.

Manual of Standard and Recommended Practice

The changes made in the Manual of Standard and Recommended Practice, as the result of action taken on recommendation of reports considered at the 1922 annual meeting and approved by formal letter ballot, have been taken care of by issuing revised loose-leaf pages to be inserted in the Manual.

Interchange Rules

The recommendations of the Arbitration Committee and the Committee on Prices for Labor and Materials, approved at the 1922 annual meeting, were incorporated in the Rules of Interchange for 1922, effective January 1, 1923. In addition, as necessity arose, this committee has approved revisions of the detailed rules which have been issued as supplements to the Rules of Interchange.

Loading Rules

The recommendations from the Committee on Loading Rules, considered at the annual meeting for 1922 and approved by letter ballot by the members, were incorporated in a revision of the loading rules for 1922, issued effective January 1, 1923.

Maximum Load Markings for Freight

Cars in Lieu of Nominal Capacity

At the meeting of the General Committee held January 11, 1923, a resolution was adopted that the recommendation from the Committee on Car Trucks contained in its 1919 report and approved by letter ballot and by the executive committee of the American Railway Association should be made effective. This recommendation was transmitted to R. H. Aishton, president of the American Railway Association, under date of January 13, 1923. At the direction of Mr. Aishton a conference was held in New York City, at the office of the association, on May 10, 1923, between representatives of the Transportation, Traffic and Mechanical Divisions to consider this matter. This conference

adopted resolutions directing that the recommendations above referred to for marking freight equipment cars to show load limit in lieu of nominal capacity be made effective. This matter is now before the Board of Directors for action, together with report relative to the possibility of increasing the loading on *B* axles having 4½-in. by 8-in. journals by making a slight increase in the condemning limit for journal wear.

Mechanical Inspection Department

The Mechanical Inspection Department of the division has throughout the year continued its investigation covering repairs to foreign cars and billing therefor on a considerable number of railroads. The conditions disclosed by these investigations have been carefully considered by this committee and a sub-committee appointed to draw up regulations governing inspection and repairs to foreign cars and billing therefor under the A. R. A. Rules of Interchange. These regulations have been approved by the General Committee and transmitted to the Board of Directors for their approval. It is the opinion of the General Committee that these regulations will materially aid in correcting such wrongful practices as have been found by the Mechanical Inspection Department.

With the approval of the Board of Direction of the association the number of inspectors was increased to 12 effective January 1, 1923.

Joint Inspection of Standard Material

A joint committee of the Purchases and Stores Division and the Mechanical Division has been making a study of the subject of joint inspection of standard materials. The final report from this committee has not yet been received.

Investigation of Power Brakes

and Power Brake Systems

The Committee on Safety Appliances, assisted by the Committee on Brakes and Brake Equipment, has been handling matters for the Association in connection with the investigation of power brakes and power brake systems before the Interstate Commerce Commission.

Extension of Effective Dates

of Rules and Regulations

As occasion has arisen during the year this committee has, upon recommendation from the proper committee of the division, extended the effective dates of certain provisions of the rules and regulations of the division. These extensions have been covered by circulars issued to the members.

American Engineering Standards' Committee

An invitation was received by this committee to arrange for participation of the Mechanical Division in the work of the American Engineering Standards' Committee. This invitation was declined.

Terms of Office for Chairman and Vice-Chairman

At the June, 1922, Convention the following resolution was unanimously adopted:

Resolved, That the officers of the Mechanical Division of the American Railway Association shall be elected annually instead of every two years, in order that a greater number of members may enjoy the honor of being officers of the division.

Section 7-B of the Rules of Order of the Mechanical Division provides that the chairman and vice-chairman of the division shall be elected by written or printed ballots alternately every two years. The candidate receiving the majority of the vote cast is to be declared elected and shall hold office for two years, or until his successor shall be elected. It is, therefore,

recommended by this committee that section 7-B of the Rules of Order of the division be revised in accordance with the proposed form shown below to provide for the election of the chairman and vice-chairman annually instead of biennially:

PRESENT FORM

The chairman and the vice-chairman of the division shall be elected by written or printed ballots alternately every second year, the candidate receiving a majority of the votes cast shall be declared elected and shall hold office for two years or until his successor shall be elected.

PROPOSED FORM

The chairman and the vice-chairman of the division shall be elected by written or printed ballots each year, the candidates receiving a majority of the votes cast shall be declared elected and shall hold office for one year or until their successors shall be elected.

Ryerson & Son Scholarships

On account of the lack of interest in these scholarships by the members of the division they have been discontinued by Joseph T. Ryerson & Son, the donors thereof.

Disposition of Bonds of American Railway Association Master Mechanics' Association

At a meeting of the committee held November 8 and 9, 1922, it was decided that all monies of the American Railway Association Master Mechanics' Association be turned over to the American Railway Association for such disposition as it may see fit to make.

Bolt and Screw Thread Standardization

The matter of bolt and screw thread standardization has been referred to the Committee on Locomotive Design and Construction for investigation and report.

Joint Committee on Fuel Conservation

Vacancies in the Mechanical Division representation on the Joint Committee on Fuel Conservation on account of members having left railroad service have been filled as follows: A. G. Trumbull, chief mechanical engineer, Erie Railroad, New York, in place of Wm. Schlafge; R. D. Hawkins, superintendent motive power, Atlantic Coast Line, Wilmington, N. C., in place of J. Hainen.

Campaign for Heavier Loading of Equipment

A joint committee composed of representatives of the General Committees, Transportation, Traffic, Mechanical, and Freight Claim Division, was appointed to formulate a plan of campaign to bring about the heavier loading of freight equipment which is being carried out under the supervision of the Car Service Division.

Upon request of the board of directors, a special committee consisting of representatives of the Car Service, Mechanical and Transportation Divisions, was appointed to analyze the National Security Owner's Car Pooling Plan and related subjects. The report of the special committee was reviewed jointly by the General Committees, Mechanical and Transportation Divisions, and submitted to the board.

Life Members

The following members have been made life members during the year:

Date Joined	Name	Title and Railroad
1903	Curry, H. M.	General Mech. Supt., Northern Pacific
1901	Deverell, A. C.	Locomotive Stoker Co.
1903	Flory, B. P.	Supt., M. P., N. Y., O. & W.
1903	Kehrmann, J. F.	M. M., Mississippi River & Bonne Terre
1903	Kleine, R. L.	Asst. to C. M. P., Pennsylvania System
1903	Kucher, T. N.	M. M., Toledo, Peoria & Western
1903	McCullough, W. A.	Gen. Road Master, Atlantic Coast Line
1903	Murphy, C. W.	Morgantown & Kingwood
1903	O'Hearne, J. E.	Denver, Colo.
1903	Pearsall, D. M.	Supt. M. P., Atlantic Coast Line
1903	Reading, R. K.	Supt. M. P., Pennsylvania System
1903	Russum, T. H.	Suprv. P. C. M., Baltimore & Ohio
1903	Torrey, F. A.	La Grange, Ill.
1903	Trumbull, A. G.	Chief Mech. Engr., Erie Railroad
1903	Yergens, W. F.	M. M., Erie Railroad

The Secretary has been advised of the death of 21 members:

Name	Railroad or Company	Died
Arp, Wm. C.	Pennsylvania Lines	June 16, 1922
Bridges, E. A.	Durham & Southern Ry.	
Chamberlin, J. T.	Medford, Mass.	Dec. 12, 1922

Name	Railroad or Company	Died
Charpiot, S. A.	San Diego, Cal.	June 6, 1922
Deveny, W. D.	Supt. Shop, A. T. & S. F. Ry.	Aug. 22, 1922
Jacobs, L. M.	Lubricating Expert, The Texas Co.	Oct. — 1921
Marden, J. W.	Waltham, Mass.	May 27, 1922
Mills, Wm.	Coach Foreman, Grand Trunk Ry. System	
Needham, E. F.	Decatur, Ill.	May 12, 1922
O'Dea, P. J.	General Inspector, Erie R. R.	— 1923
Pearce, J. S.	M. M., Norfolk & Western Ry.	Sept., 1919
Perkinson, T. F.	M. M., Baltimore & Ohio R. R.	July 10, 1922
Place, T. W.	Waterloo, Ia.	Oct. 9, 1922
Porter C. C.	Manager, Sugar Land Ry.	
Quayle, Robt.	Retired G. S. M. P. & M. C. & N. W. Ry.	Sept. 13, 1922
Queenan, Wm.	Asst. S. S., C. B. & Q. R. Ry.	Nov. 28, 1922
Ryan, Patrick	M. M., Louisville & Nashville R. R.	March 2, 1921
Schrader, J. R.	D. G. C. F., New York Central R. R.	Aug. 11, 1922
Smith, F. J.	M. M., Chicago Great Western R. R.	June 23, 1923
Stoll, W. J.	Chief Interchange Inspector, Toledo, O.	
Williams, E. A.	Glen Ridge, N. J.	April 29, 1922

Suitable committees will be appointed to prepare obituaries for these deceased members to be included in the proceedings of this meeting.

Committee on Nominations

The committee recommends that no ballot be taken this year for members of the Committee on Nominations. The present Committee on Nominations is composed entirely of past presidents of the former Master Car Builders' and Master Mechanics' Association and past chairmen of the Mechanical Division. The Committee on Nominations consists of the following:

F. W. Brazier (Chairman), assistant to general superintendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power & equipment, Central Railroad of New Jersey; W. J. Tollerton, general mechanical superintendent, Chicago, Rock Island & Pacific.

The report is signed by J. Coleman (Chairman) general superintendent car equipment, Canadian National Railways; John Purcell, (Vice-Chairman), assistant to vice-president, Atchison, Topeka & Santa Fe; C. E. Fuller, superintendent motive power and machinery, Union Pacific; J. S. Lentz, master car builder, Lehigh Valley; H. L. Ingersoll, assistant to president, New York Central; J. J. Tatum, superintendent car department, Baltimore & Ohio; Willard Kells, superintendent motive power, Atlantic Coast Line; W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific; H. C. Oviatt, general mechanical superintendent, New York, New Haven & Hartford; C. F. Giles, superintendent machinery, Louisville & Nashville; T. H. Goodnow, superintendent car department, Chicago & North Western; J. T. Wallis, chief of motive power, Pennsylvania system; A. Kearney, superintendent motive power, Norfolk & Western; C. E. Chambers, superintendent motive power and equipment, Central Railroad of New Jersey, and L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

Discussion and Action

A motion was carried that the action of the General Committee eliminating the ballot for members of the committee on nominations be approved.

A motion was carried that the recommendation of the General Committee for a change in Section 7-b of the Rules of Order to provide for election of officers annually instead of bi-annually to become effective immediately, be approved.

A motion was carried that the report of the General Committee be approved as a whole.

THE UNION PACIFIC, through a holding company known as the Kansas City Industrial Land Company, has acquired 919 acres of land in the North Missouri river bottoms, Kansas City, Kan. It is understood that this land, which cost approximately \$440,000, will be used in the development of a new industrial district.

VALUATION OF THE railroads of Colorado as assessed for this year is \$160,816,910, compared with \$160,487,820 for 1922. The Colorado & Southern, the Chicago, Burlington & Quincy, the Atchison, Topeka & Santa Fe and the Denver & Rio Grande Western were valued the same for each year while the Union Pacific value was increased \$750,000 over 1922.

Report of the Committee on Car Construction

Standard Box Car Designs Including Single-Sheathed and Double-Sheathed Types Submitted

THIS COMMITTEE carefully considered the various subjects assigned to it, especially that relating to the design of box cars and their trucks. The following is an abstract of the committee's report:

Car Door Fasteners

A recommendation was made to the effect that steps should be taken to bring about an improvement in the present car door fasteners, as those commonly used are inadequate and do not afford shipments proper protection.

Attention was called to various mechanical locking devices, now being worked out by various railroad car departments.

The committee investigated designs made by the Delaware, Lackawanna & Western, Union Pacific, and Atchison, Topeka & Santa Fe. After a thorough consideration of these designs, it was concluded that the A. R. A. standard box car details already include a burglar-proof guide for use in connection with a bottom Z-bar, and if properly applied with a Z-bar track at the top, with the clearances prescribed by sheet 26 of the A. R. A. Standards, it is doubtful if the door could be lifted over the rear guide.

Probably a great deal of the existing complaint in regard to box

land, Oregon, May 16-18, a committee was appointed for the purpose of handling the question of permanently fastening end doors on box cars, this subject being under consideration on account of

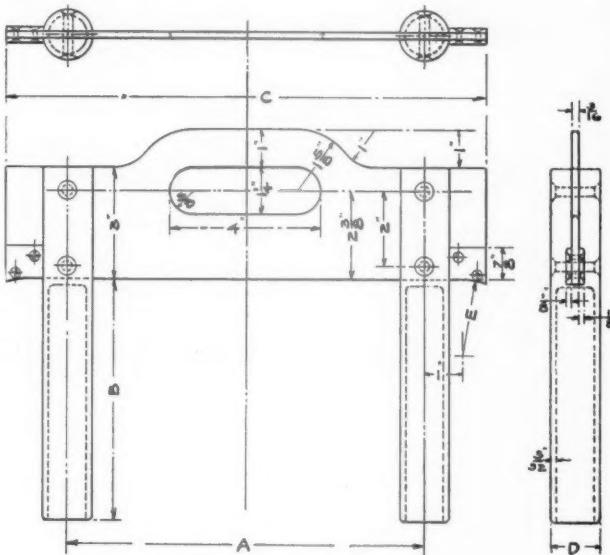


Fig. 2

its relation to the question of claim prevention. The committee made the following recommendation:

"We recommend the entire abolition of end doors, as rapidly as traffic conditions will permit. As long as the end doors are

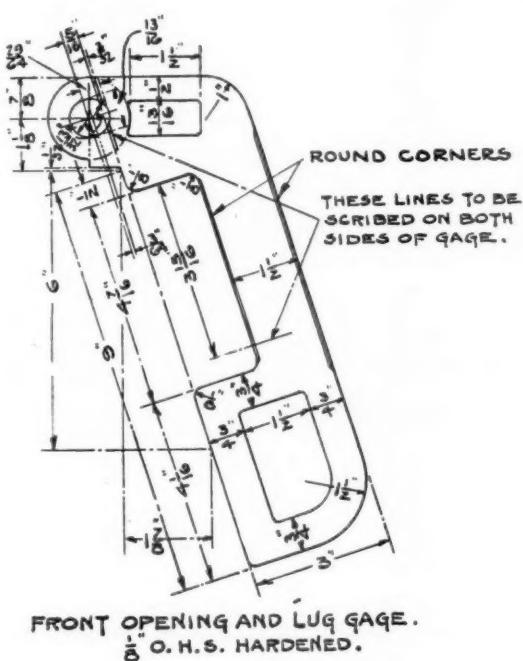


Fig. 1

car door fastenings is caused by the large number of doors running with bottom guides that have only a short lap over the door, or where the bottom of the door is not sufficiently protected, and decays, so that it may be readily lifted over the rear guide. It is believed that if the standard drawings and door specifications of the A. R. A. Mechanical Division are followed, the doors will be sufficiently burglar-proof for all ordinary service. (See also report in the 1920 Proceedings.)

However, there may be cars assigned to regular territory, or regularly engaged in hauling costly commodities, where it appears desirable to provide fastenings of more than ordinary security, and it is recommended that such cases be handled by individual railroads, to suit their particular requirements.

Permanently Fastening End Doors on Box Cars

The following recommendation was received from the Pacific Coast Claim Conference, Los Angeles, Calif., dated June 9, 1922:

"At the meeting of the Pacific Coast Claim Conference, Port-

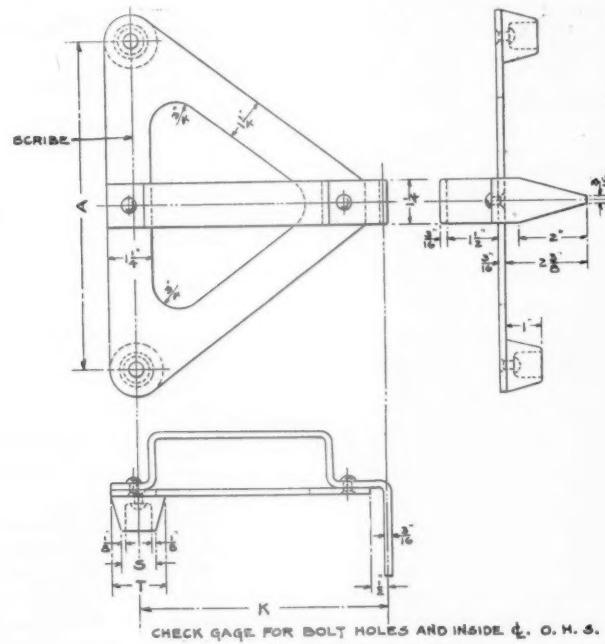
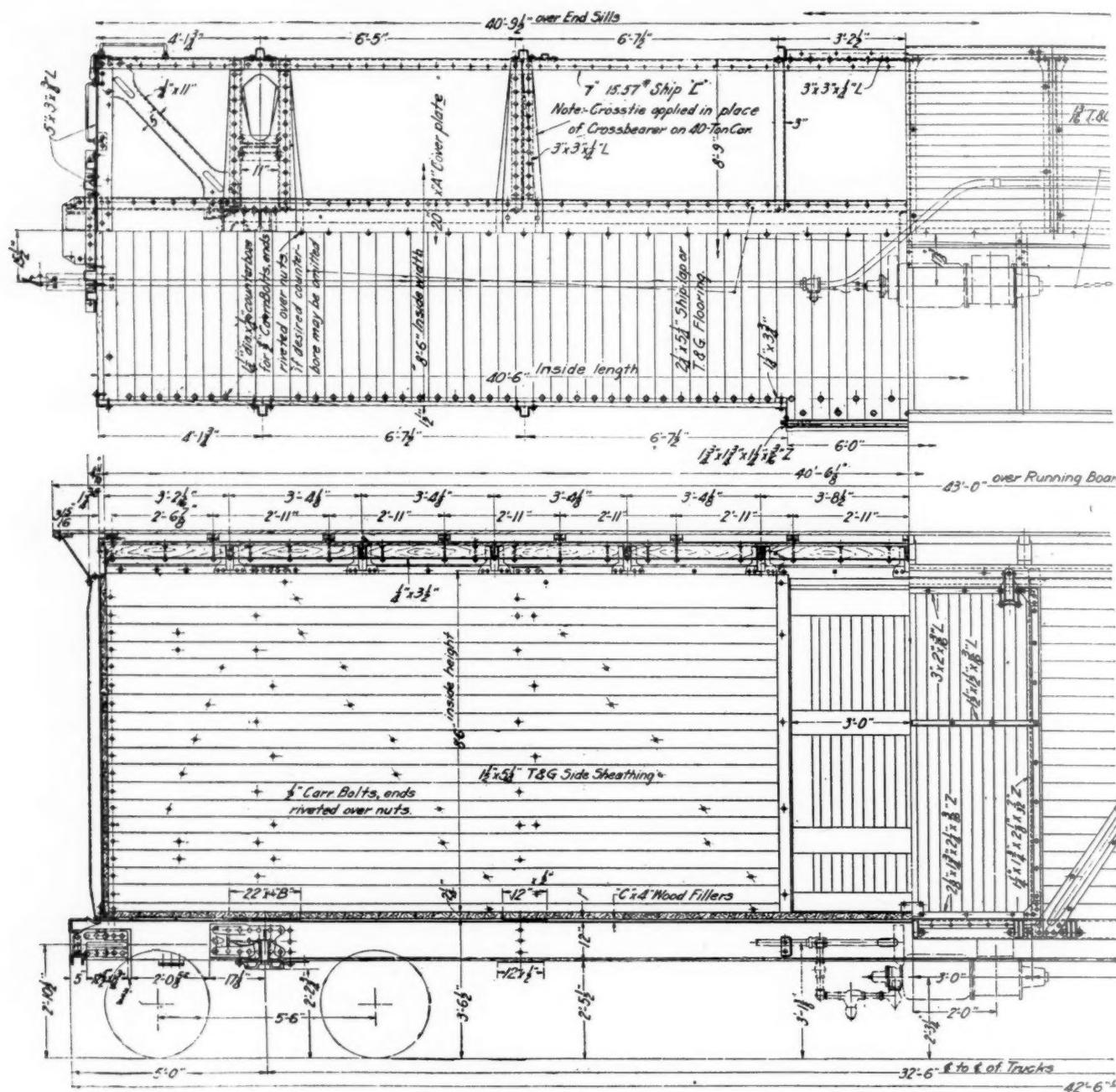


Fig. 3

used they shall be maintained in as substantial a manner as side doors."

We concur in these recommendations, and, therefore, suggest that Fig. 9, Section "C," page 60, in the Manual and the reading in the middle of page 47, relating thereto, be eliminated; but that



General Arrangement of Single-Sheathed

the reading relating to the sealing of end doors, at bottom of page 47, should remain as at present.

Defective Equipment—Needed Improvement in Condition of Side Doors

The following recommendation was received from the Pacific Coast Claim Conference, dated June 9, 1922:

"Due to heavy claim expenditures resulting from pilferage and shortage of freight, which it often is difficult to guard against when doors and fastenings are defective, the Pacific Coast Claims Conference earnestly recommends that steps be taken by the A. R. A., Section Five, to make the recommended practice of that Section, as to the application of doors and door fixtures, the standard practice, allowing the use of either flush or non-flush doors, and to prevent the interchange of cars built after some selected date, unless equipped in the manner prescribed. Also that the doors on old cars be so equipped after a reasonable length of time."

The committee concurs in this recommendation, believing that it resolves itself into a question of interchange rules, and recommends to the association to determine whether the loss due to the

imperfect condition of doors on existing cars would justify the necessary expenditure to equip the doors in accordance with the recommended practice of the Mechanical Division, which the committee feels would entirely overcome the difficulty.

The committee further believes that such investigation will lead to formulation of interchange rules which will make it obligatory that cars be maintained in accord with A. R. A. standards.

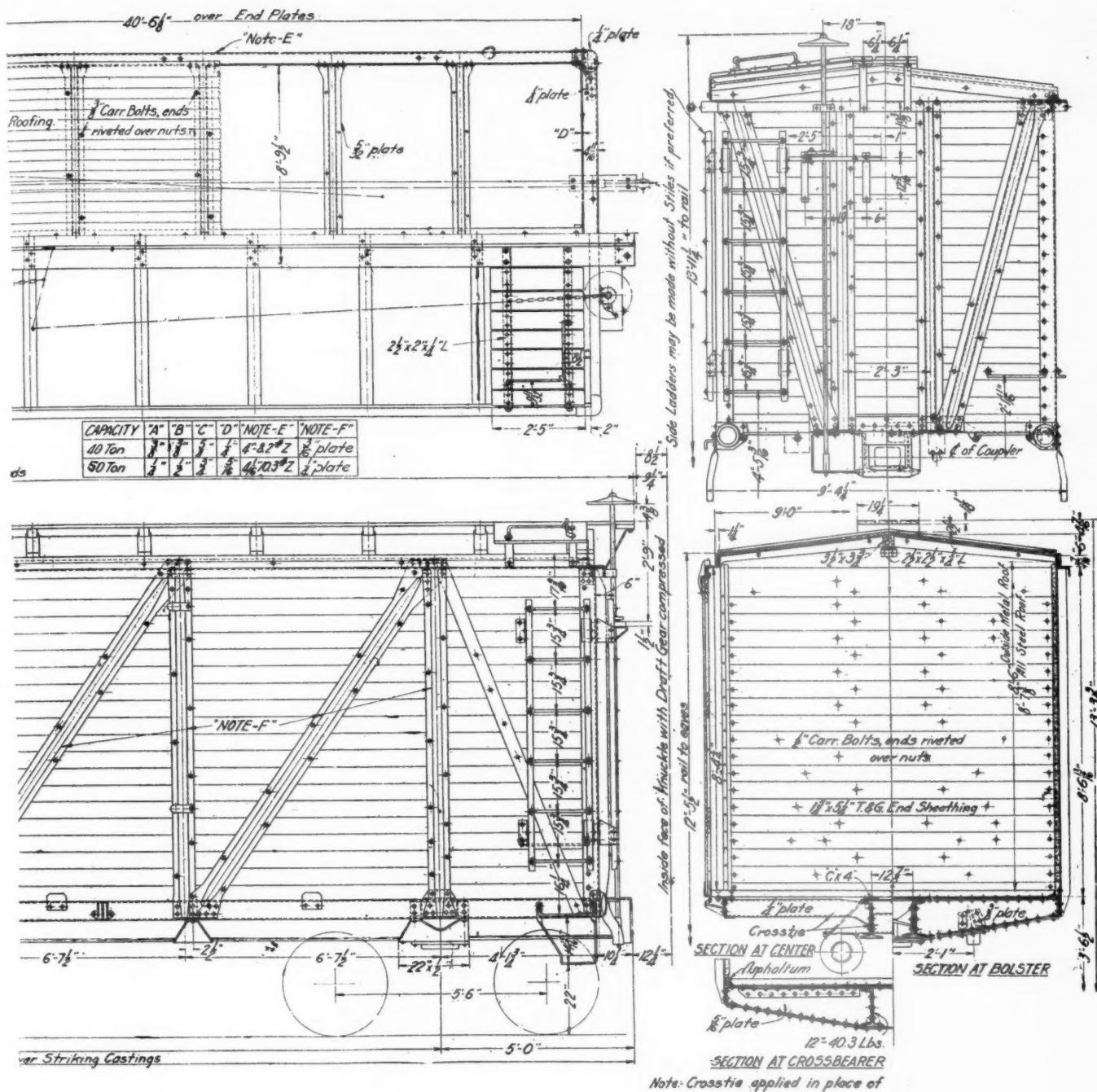
**Journal Box Gages for Bolt Hole, Dust
Guard Opening, Lid Lug and Wedge Seats**

Various manufacturers have requested drawings.

Various manufacturers have requested drawings. The gages shown in the Manual are not up-to-date, since minor modifications have been made in the boxes from time to time. It was, therefore, necessary to correct the existing gages, and to indicate gages for boxes not now covered.

Fundamentals—Center Sill Area

The committee therefore, submits the design of gages shown in Figs. 1-5 inclusive, for adoption as standard, in connection with the present existing designs of journal boxes, class C, D, E, and F.



A. R. A. Standard Box Cars, Classes 4C and 4D

For box type cars, the roof structure reinforces the top chords of the sides, thereby preserving the alignment, and furnishes a measure of strength permitting a reduction of center sill area. Hence the center sill area may be reduced by 2 sq. in., making the minimum center sill area for such cars 28 sq. in.

It is hereby recommended that this be adopted as standard, and that item 12, page D/3, of the Manual, be amplified, as follows:

12. Area of center sills between rear followers (minimum).

For cars not equipped with roofs, 30 sq. in.

For cars equipped with roofs, 28 sq. in.

Limiting Outline for Freight Cars

A thorough investigation of available information relating to clearances of all railroads was made, to determine the outline to which A. R. A. cars should be designed. As a matter of record, we present Fig. 6, which was selected. The designs made by the committee will be held within this outline.

The capacity of one "F" axle is 60,000 lb. The estimated average weight of four axles and eight wheels is 11,000 lb. From this, the maximum weight on rails of a loaded car, equipped with four "F" axles, will be 251,000 lb.

It is recommended that this weight be adopted as the standard and incorporated in the Rules of Interchange.

Standard Cars

In compliance with instructions to prepare box car designs, the committee made a thorough investigation of the state of the art, including the present day requirements, and selected a basis contemplated to result in a car of adequate strength and minimum weight, with minimum cost of maintenance. Fundamentals covering present day requirements and adequate strength have been submitted to the division heretofore, and have been adopted as standard.

The committee is now pleased to submit the design covered by cuts herewith, of single and double sheathed cars of both 4/C and 4/D types.

These designs represent a redesign of a first design, which had been thoroughly criticised by the members of the committee, and by the committee of the Railway Car Manufacturers' Association, to whom it was submitted for suggestions that would facilitate production.

It will be noted that the center sill construction is the same for

all of the designs, differing only in so far as adjustment must be made for difference in capacity, difference in foundation brake, and difference in draft attachments.

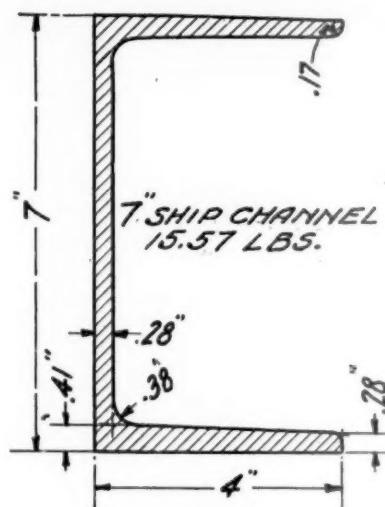
In the 4/C cars the cover plate is $\frac{3}{8}$ in. thick, and cross ties are substituted for cross beams, at a material saving in weight, compared with the 4/D cars, which have crossbearers and a $\frac{1}{4}$ in. center sill cover plate.

The center sill section recently adopted, on account of being the most economical section that can be used, has been incorporated.

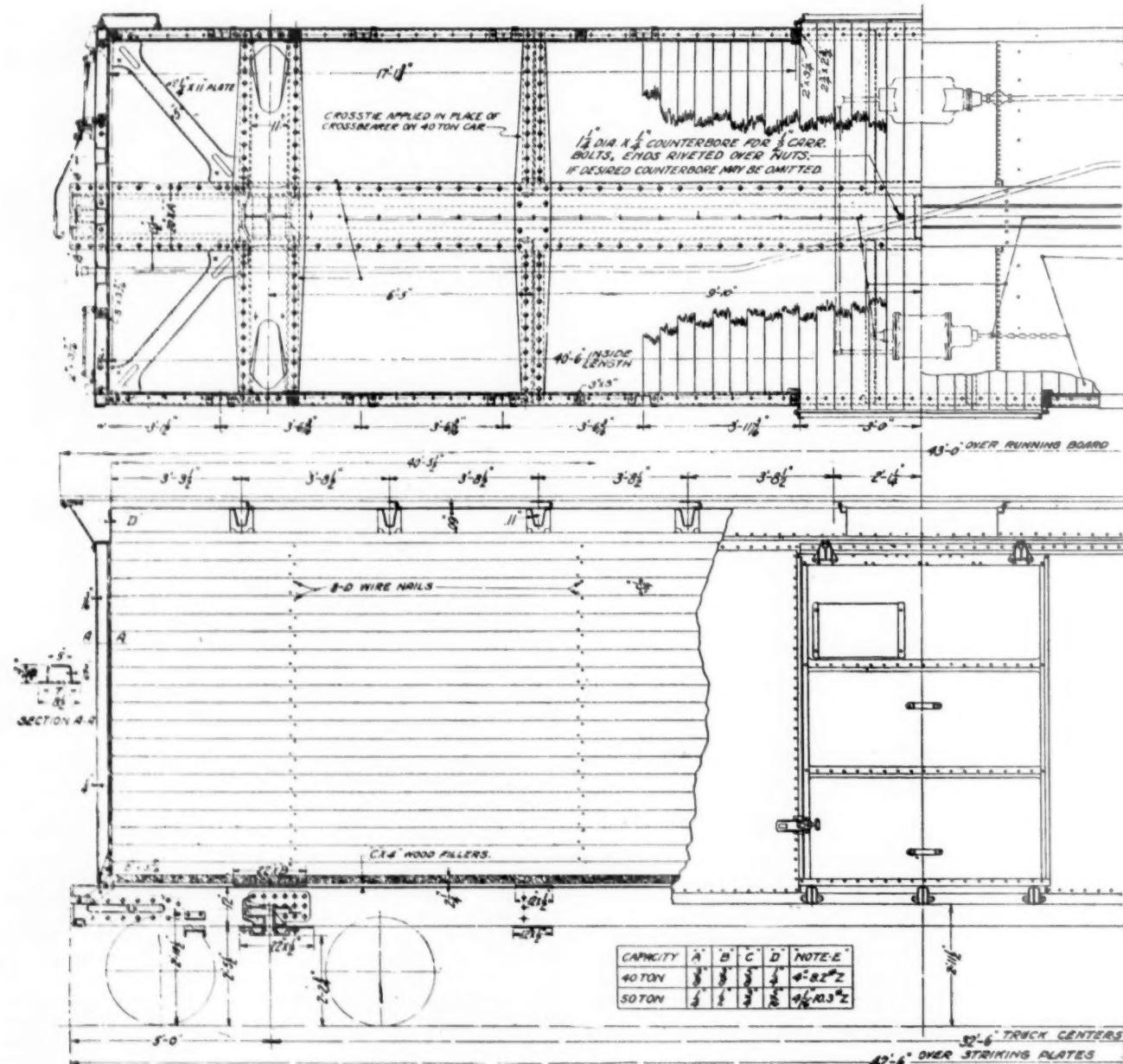
The side sills are of a new channel section, 7 in. deep with 4 in. flanges, which has many advantages over the standard channels. The committee has specified that they should be made of copper bearing open hearth steel. The distance over side sill channels must, necessarily, be less for the single sheathed car than for the double sheathed car, which is also reflected in the length of bolsters, crossbearers, and cross ties.

Adjustment in the inside width of the car was made to provide the same dimensions over the flanges of the Z-bar top plates, thereby making all roofs interchangeable. For this reason, the double sheathed car is about 3 in. wider inside than the single sheathed car.

We show two designs of roof, which are, as far as we know, the best of their respective types; one is a metal covered wooden roof, and the other an all-steel riveted roof. Either roof may be



Cross Section of Special Side Sill Channel for Standard Box Cars



General Arrangement of A. R. A. Standard

used on any of the four designs, and other roofs preferred by individual railroads should be equal in strength and serviceability, and interchangeable with those shown.

The ends of the center sills are arranged for the use of a vertical

draft gear yoke on the single sheathed car, and for a horizontal draft gear yoke on the double sheathed car. Since the center sills are interchangeable, new cars of any of the four designs can be arranged for either vertical or horizontal yoke draft attachment, and for either type of body brake arrangement.

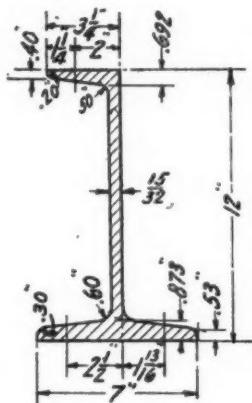
The combined bolster filler and backstop casting shown in the design is recommended for use, provided the owner or owners of patents on the combined bolster filler and backstop casting permit the free use of the combined bolster filler and backstop casting, without restriction or any obligation whatsoever, by any railroad or car owner whose cars are used under the jurisdiction of the A. R. A. or its successors.

Other alternate detail designs have been incorporated, which may be used on any of the four car designs, as preferred.

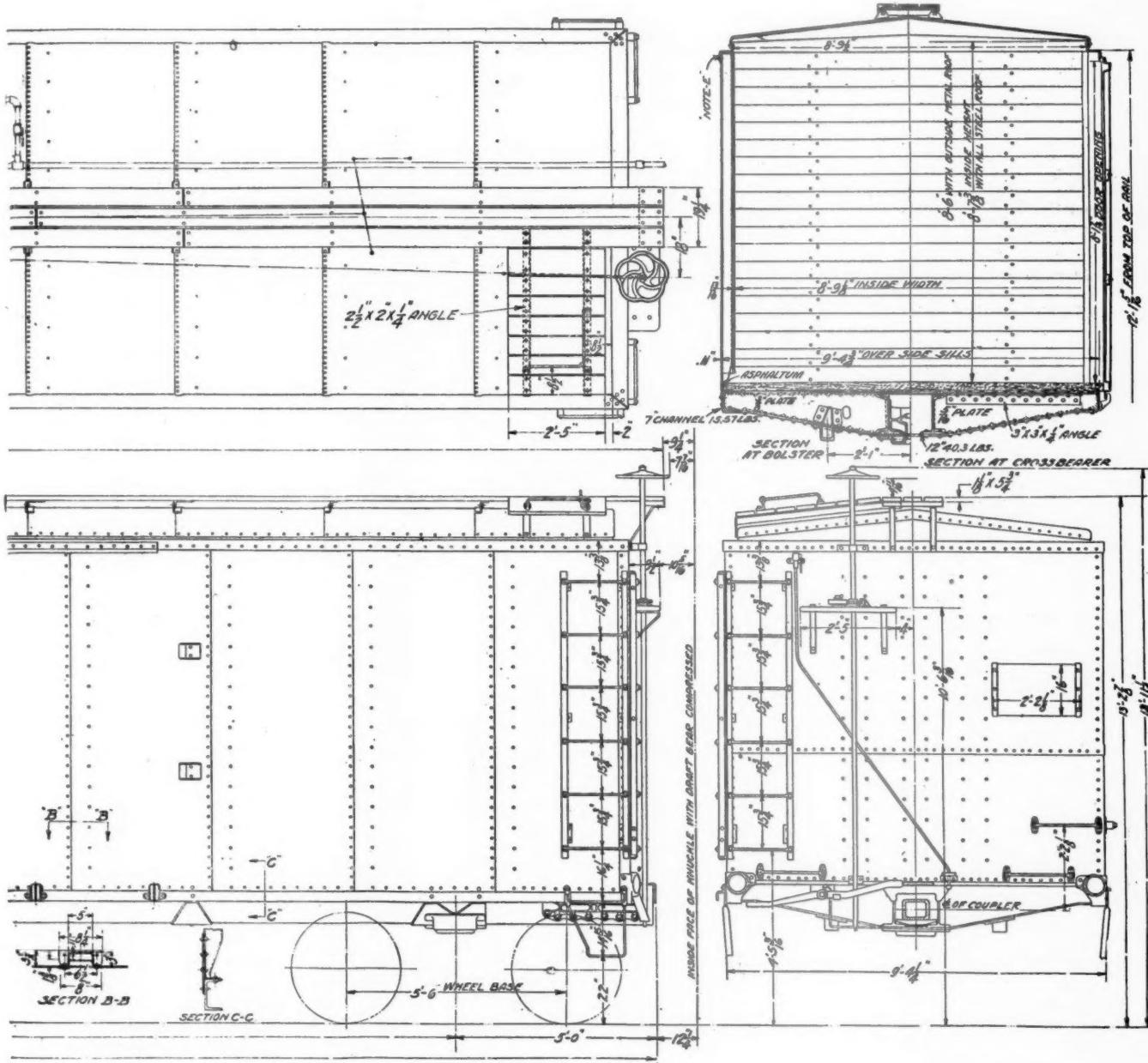
The foundation brake arrangements are of the two types now in general use; one with the cylinder and reservoir bolted together, and one with the cylinder and reservoir separate, and located on opposite sides of the car.

The hand brake power, based on 1,500 lb. pull on chain, has been made approximately equal to the air brake power, based on 50 lb. cylinder pressure.

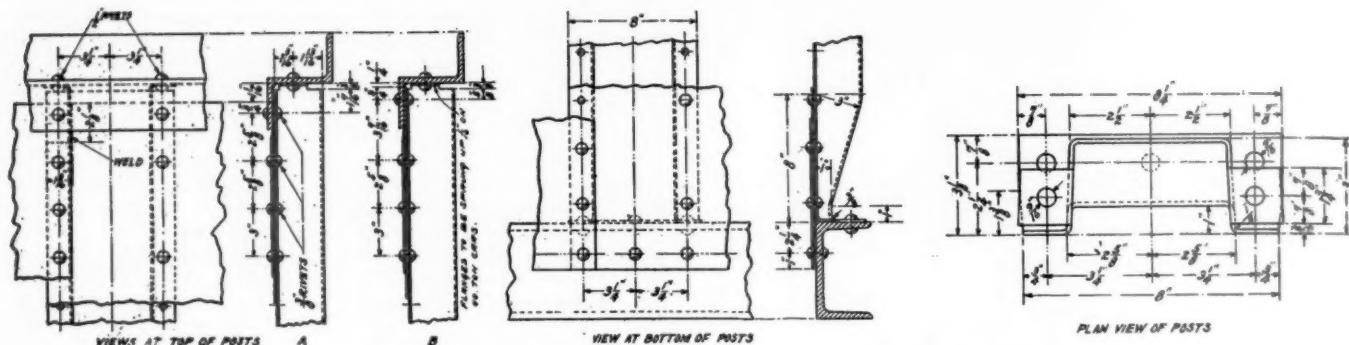
Since the most vital part of a car is embodied in coupler, draft gear and draft attachments, a great amount of attention was directed to this part of the design. The type D coupler, which is



Cross Section of Center Sill Members for Standard Box Cars



Double Sheathed Box Cars, Classes 4C and 4D

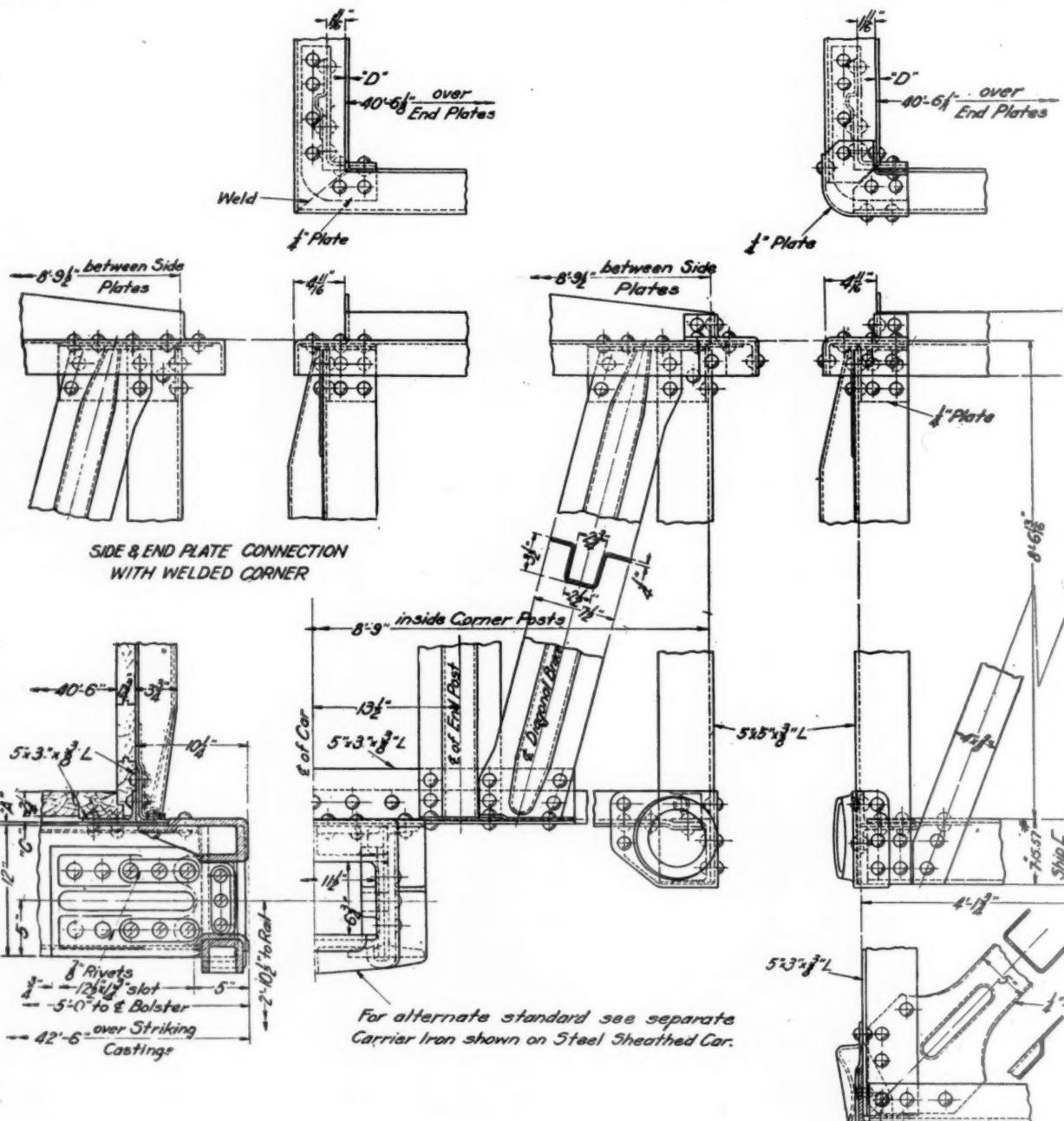


Details of Parts and Methods of Fastening, Double Sheathed Cars

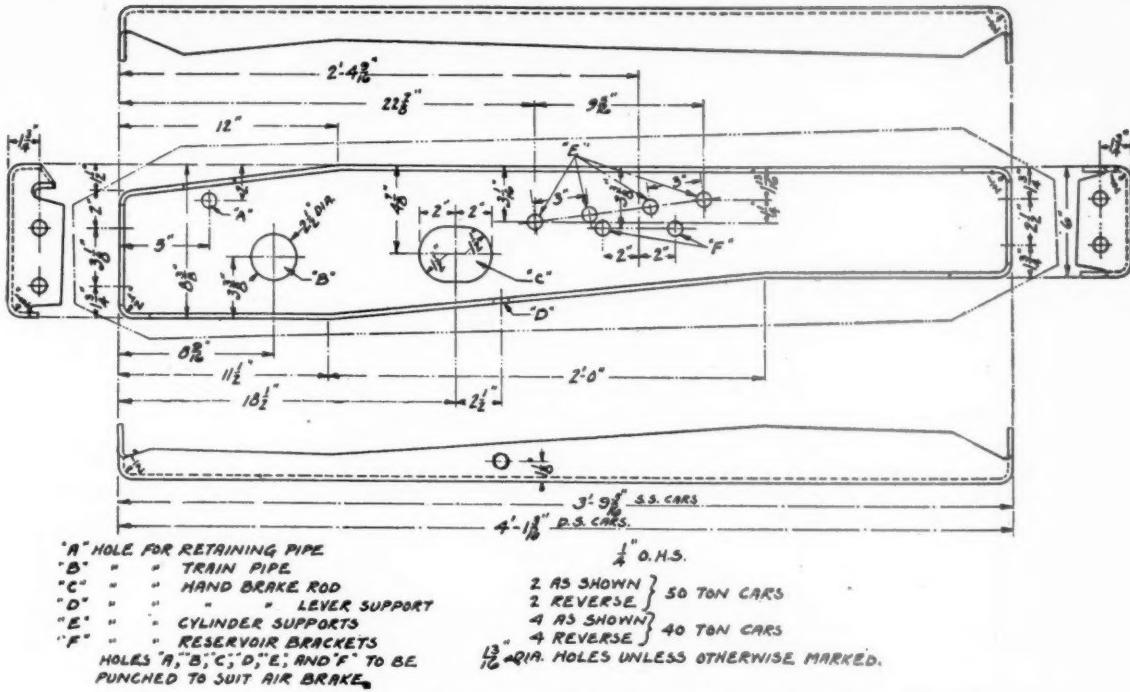
now standard, may be considered equivalent to 15 sq. in. of solid class A cast steel, that is, it will begin to take a permanent set at closely the same compression force as that which would begin to produce a permanent set in a bar of class A cast steel having an area of 15 sq. in.

The committee suggest that the draft gear used should be equivalent to 20 sq. in. of class A cast steel.

The draft gear backstop should be attached to the webs of the center sills with not less than thirty-six $\frac{3}{8}$ in. rivets, driven to solidly fill 15/16 in. holes. These do not include the additional



Arrangement of Framing of Single



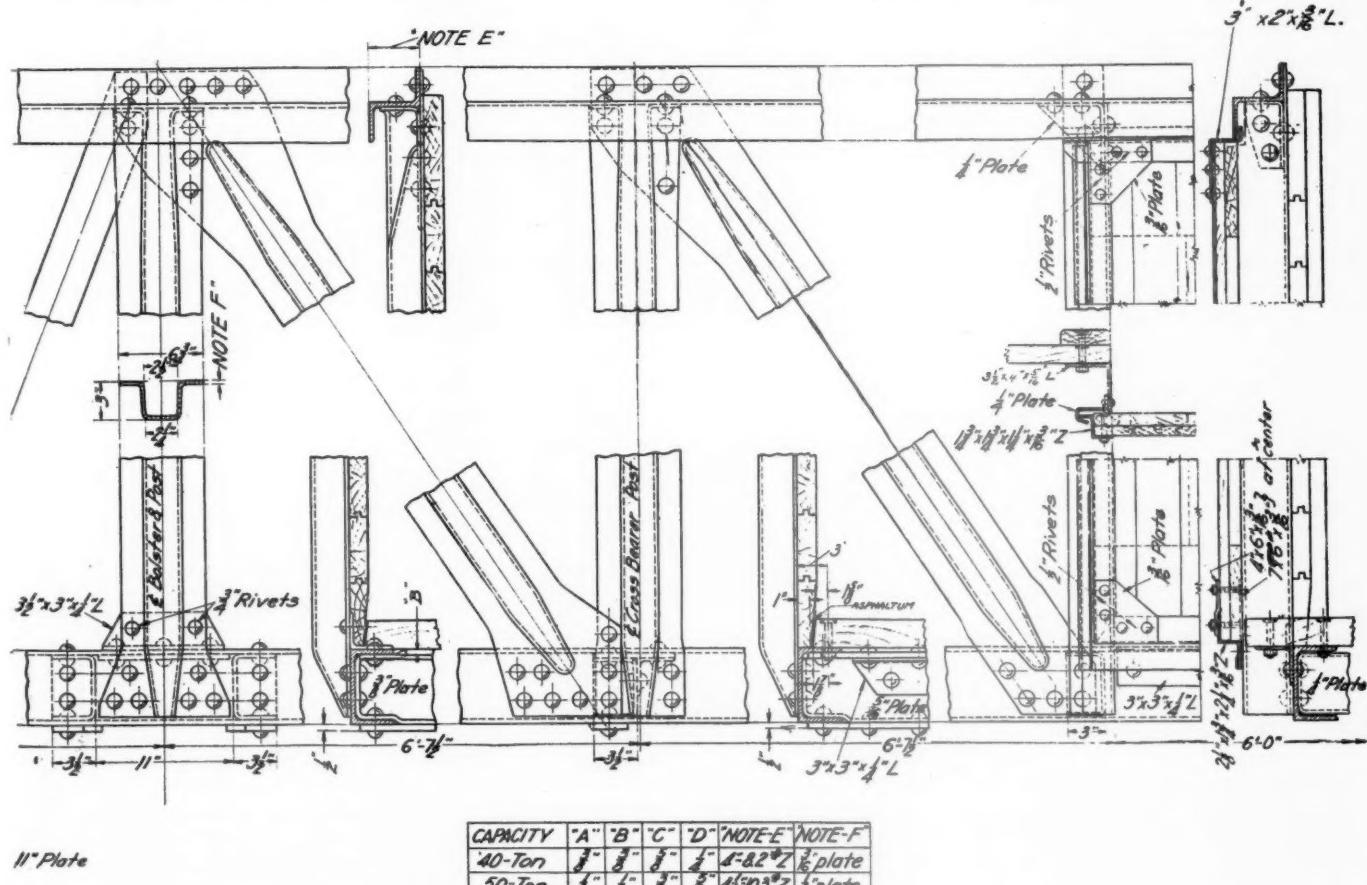
Detail of Cross Tie, Single and Double Sheathed Cars, Classes 4C and 4D

rivets which may be required through the bottom flanges or top and bottom cover plates.

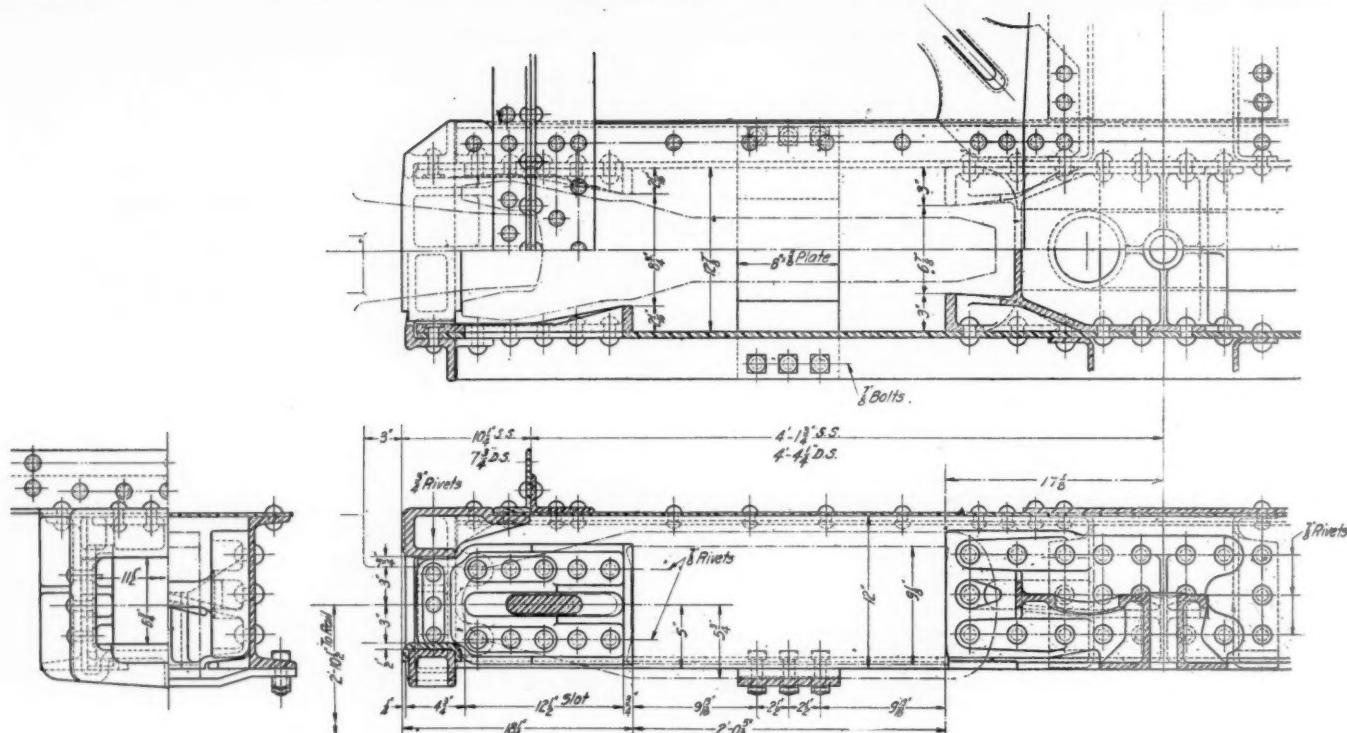
The space for draft gear and followers is 24 1/8 in. in length, and 12 1/2 in. (distance between center sills) in width.

For draft gears embodying transverse springs, holes may be cut into the webs of the center sills, as required.

To provide for facilitating interchangeability of roofs, the dimensions over outside of flanges of side plates are 8 ft. 10 1/2 in., and of end plates are 40 ft. 6 1/8 in. for all cars. Likewise the height of doors has been made 8 ft. 5 3/4 in., and the width 6 ft. 3 in., for all cars. The car ends could not be made interchangeable without detriment to the car designs.



Sheathed Cars, Classes 4C and 4D



Arrangement at Draft Gear, Single and Double Sheathed Cars with Vertical Yoke Draft Gear Classes, 4C and 4D

General specifications for these cars have been prepared, and are appended hereto.

The estimated weight of each car, based on using fir lumber, is 40,000 lb. for the single sheathed 4/C car, 43,000 lb. for the single sheathed 4/D car and, correspondingly, about 500 lb. more for the doubled sheathed cars, each based on detail design as shown.

Probably more time and study are embodied in these designs than in any previous design, but it is expected that when the first cars are built slight modifications will be found advisable, to better facilitate shop operations. The committee will incorporate such modifications in the design, and will add details as required.

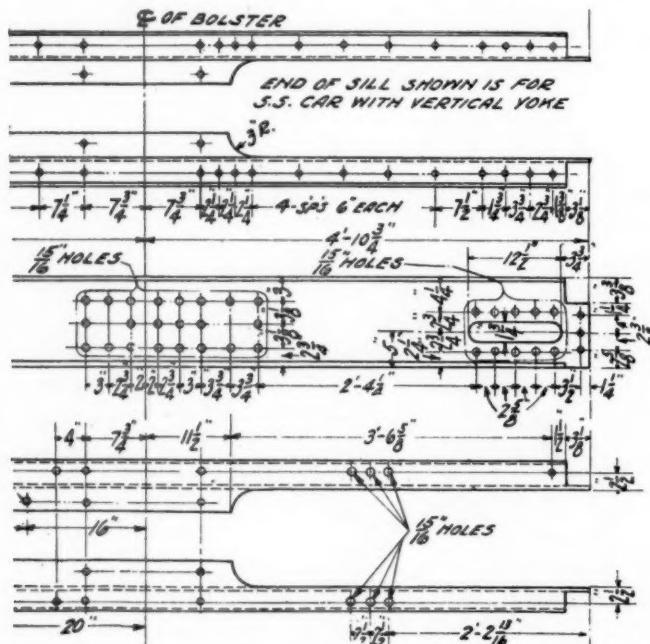
To complete the design of these box cars it was necessary to also include designs of trucks.

Whatever truck design is now adopted will, naturally, have to

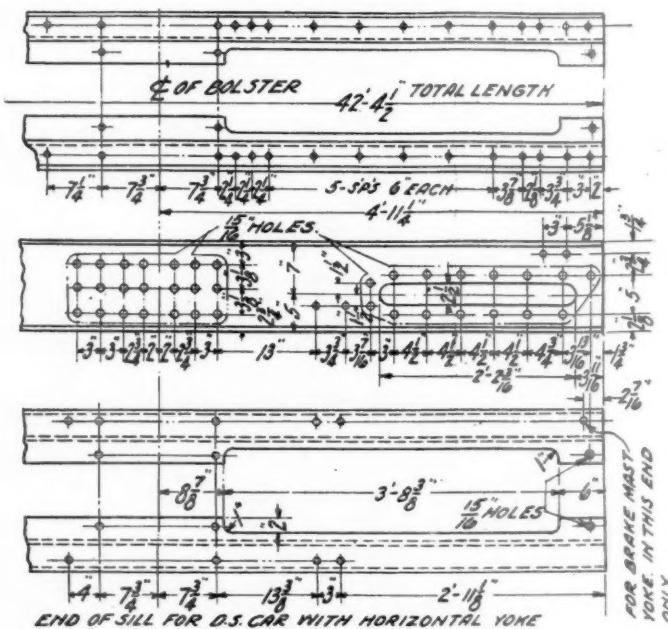
also fit any other types of cars that may be used in the future. It was, therefore, deemed desirable to design trucks of the 2/C, 2/D and 2/E classes, on the basis of minimum weight and adequate strength, to meet loaded car weights equal to the axle capacities.

The committee submits, for approval, as standard trucks, the 2/C, 2/D and 2/E types shown on the general plan, with alternates covering side frames having either integral or separable boxes.

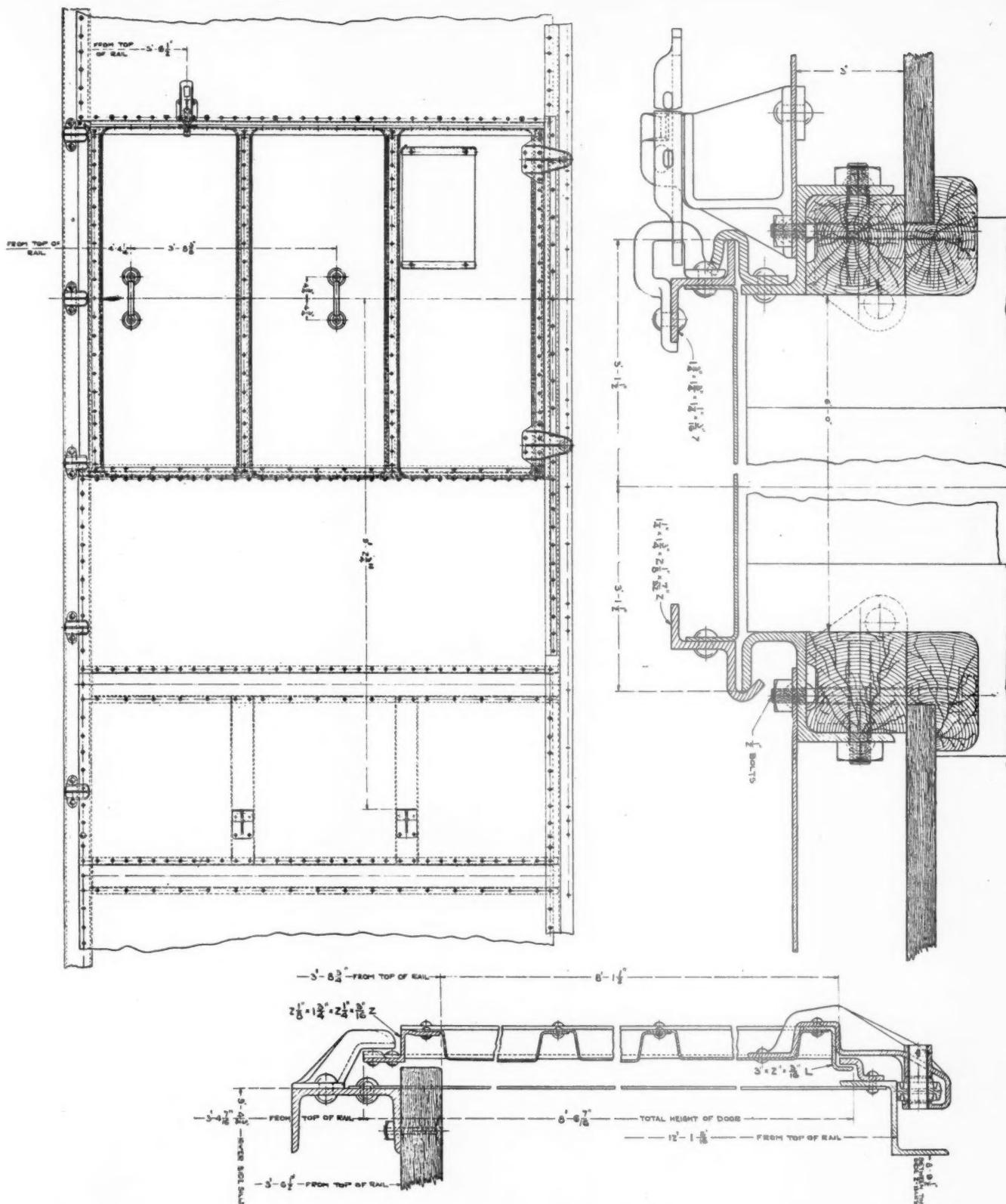
Bolster designs cover cast steel bolsters with integral and separable center plates, also pressed steel bolsters. The general drawing shows the recommendations for all the general fixed limitations. A special effort was made to maintain as large a distance between the top of the rail and the bottom of the side frame as possible. The committee believes that this distance, under any conditions of service, should not be less than $4\frac{1}{2}$ in.



**End of Center Sills
Single Sheathed Cars with Vertical Yoke**



**End of Center Sills
Double Sheathed Cars with Horizontal Yoke**



Steel Door Arrangement Shown Applied to D. S. Car, Single and Double Sheathed Cars, Classes 4C and 4D

A. R. A. standard fundamentals have been observed throughout.

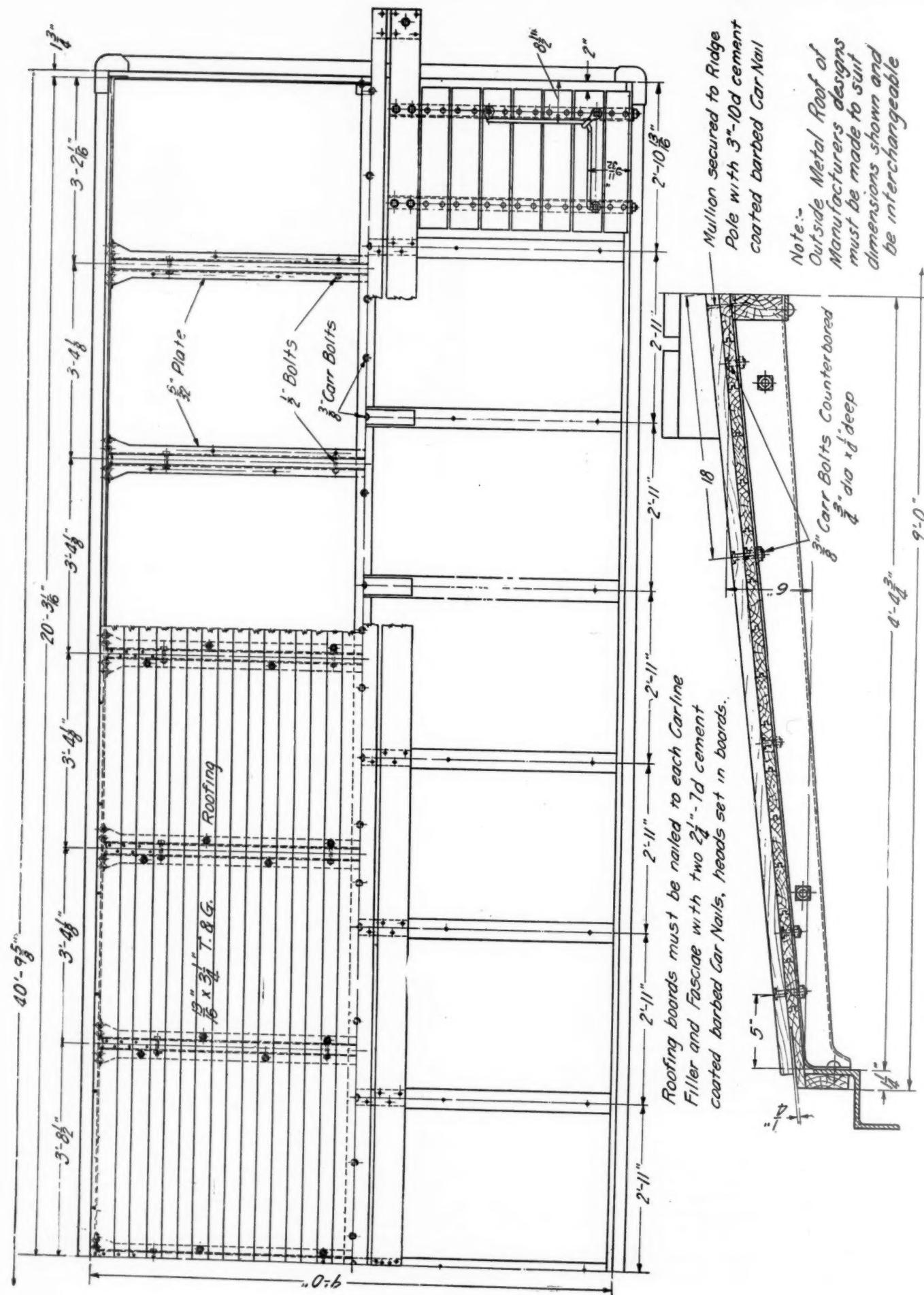
The stresses in side frames, bolsters, and other parts, have been very carefully calculated on generally accepted methods of calculation. It is the intent of the committee, at some time in the future, to submit to the association methods on which side frames and bolsters should be calculated and tested, similar to the data formerly submitted for axles.

It will be noted that two types of journal boxes, lettered W and Y are shown. Box W shows a development of the desire to pro-

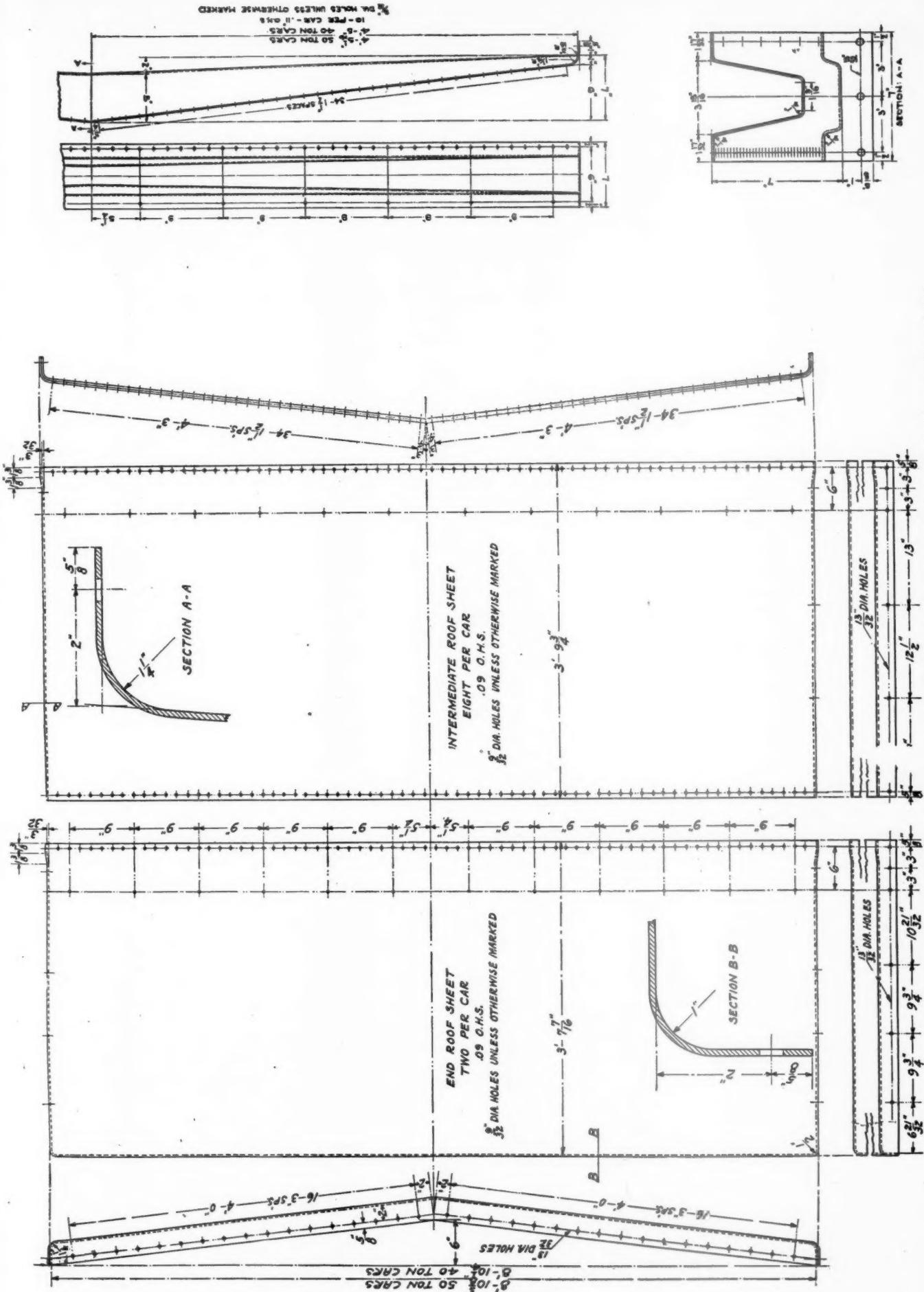
vide a separable box side frame as light as possible, which does away with some of the trouble experienced with the ordinary box bolt. Box Y shows the side frame and box cast integral.

The arrangement as shown with boxes W and Y give, by far, the lightest side frames of any satisfactory design considered, and are recommended for adoption as alternate standards.

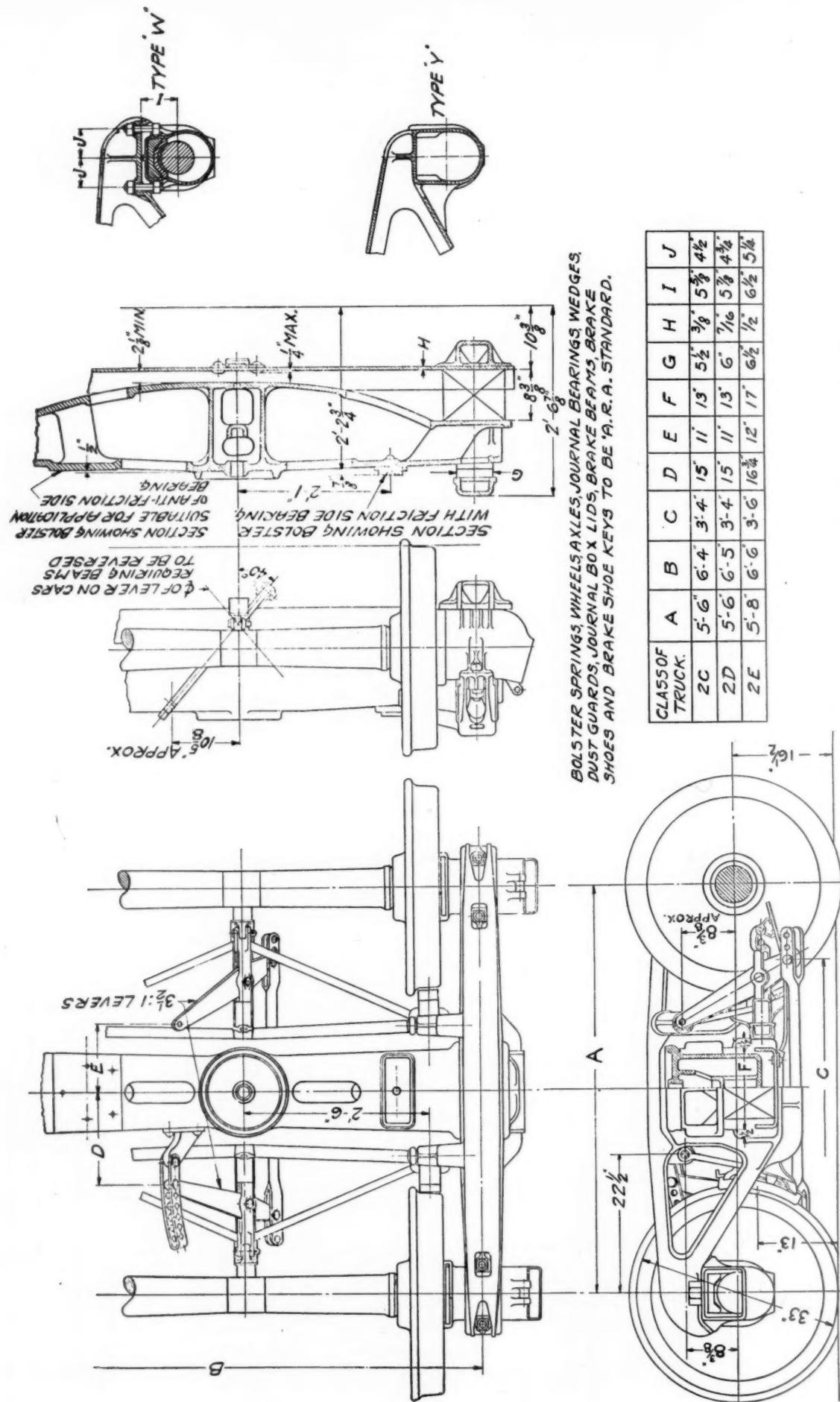
The opening for the bolster in the side frames provides for sufficient clearance over the top of the bolster to provide for lining up under the springs to compensate for 1 1/2 in. reduction in radius

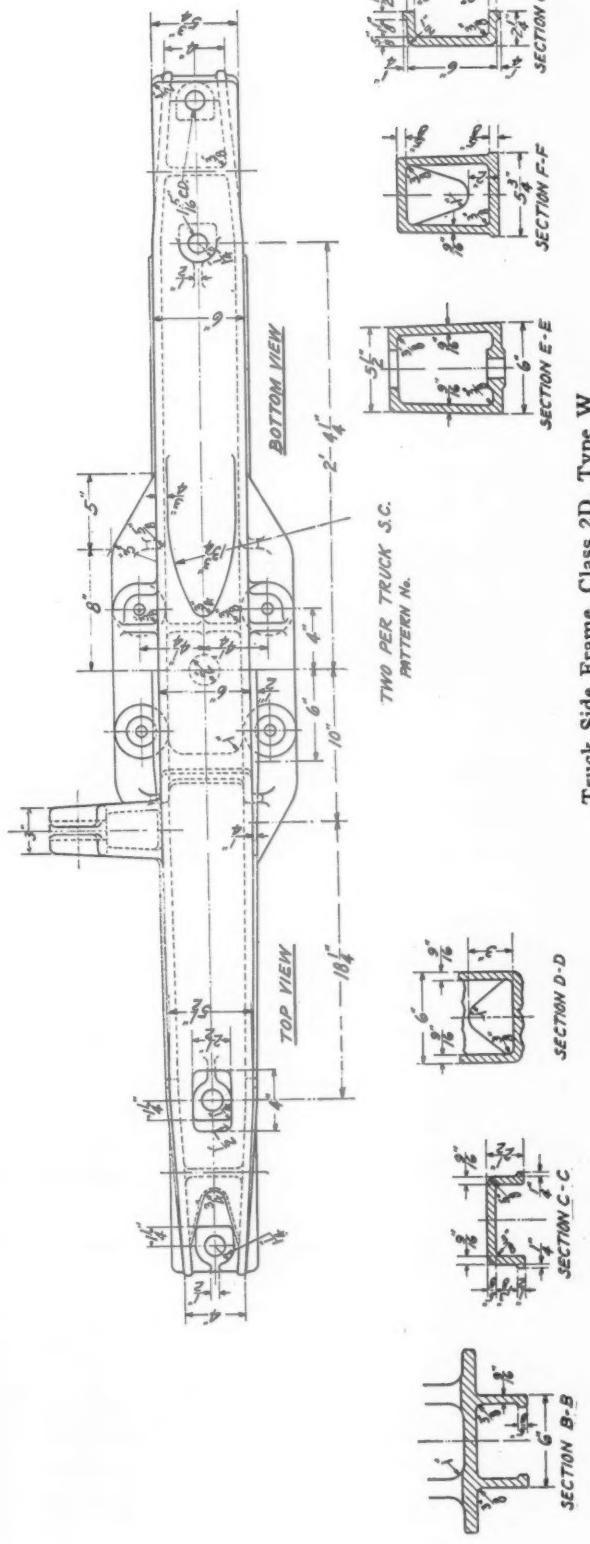
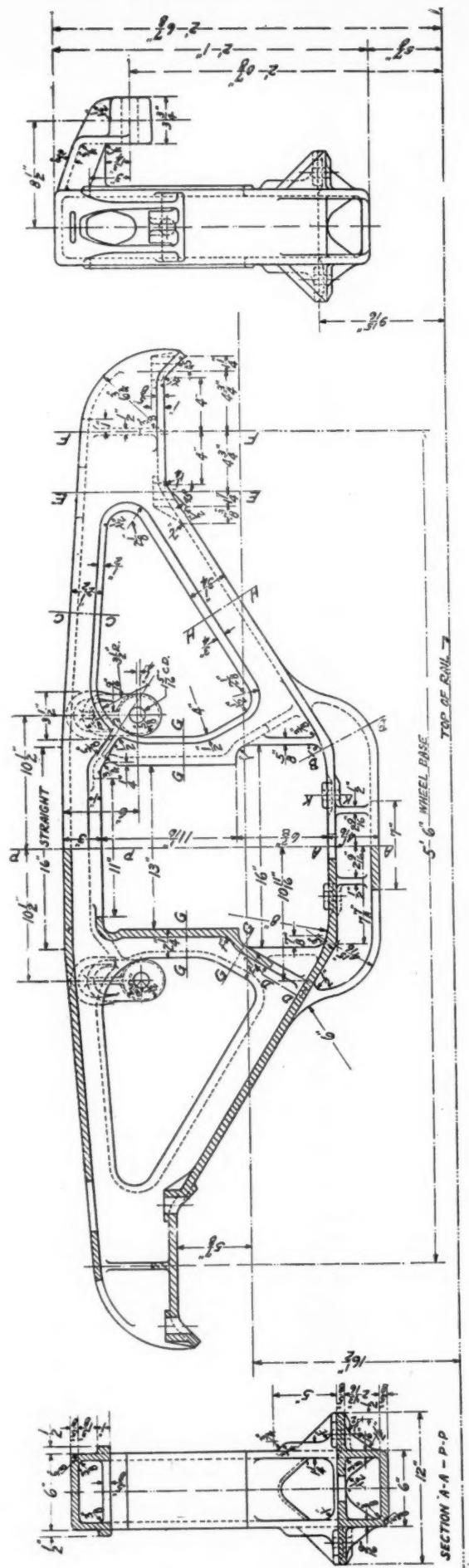


Roof Arrangement, Single and Double Sheathed Cars with Outside Metal Roof, Classes 4C and 4D



Roof Sheets and Carlins, Single and Double Sheathed Cars with All-Steel Roof, Classes 4C and 4D





Truck Side Frame, Class 2D, Type W

of wrought steel wheels, and reasonable wear on journals and brasses. This opening has also been arranged to facilitate the use of Barber or similar rollers under the bolster ends for roads which prefer that construction.

The guide for the live lever has been entirely omitted. The guide for the dead lever has been made exactly the same for all trucks.

On the 2/E truck the pin connecting the lever with the dead lever guide would have to be applied in the second hole, instead of the first hole. The dead lever guide fulcrum bracket is the

Many inquiries relating to whether it is intended that these designs become obligatory in every detail impels us to repeat the statement made in our report, dated June 6, 1921:

"The intent of the committee is to make designs that will establish fixed conditions, permitting the use of detail designs standardized by the association, or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts, or group of parts, are the equivalent in strength, service and safety of, and interchangeable with, the standard part or group of parts replaced."

Patents

The patent situation on detail parts has been investigated to some extent. A more complete investigation will have to be made, in order to determine clearly in how far patents on which royalties may be required obtain. This committee expects to make modifications that may seem desirable to eliminate the necessity of paying royalties where an equally good design, not subject to patents, can be substituted.

Instructions have been requested concerning how the patent situation shall be handled. It is the intent of the committee to pursue the question of patents as thoroughly as possible, as soon as the instructions requested materialize.

If any members of the association find anything in the designs

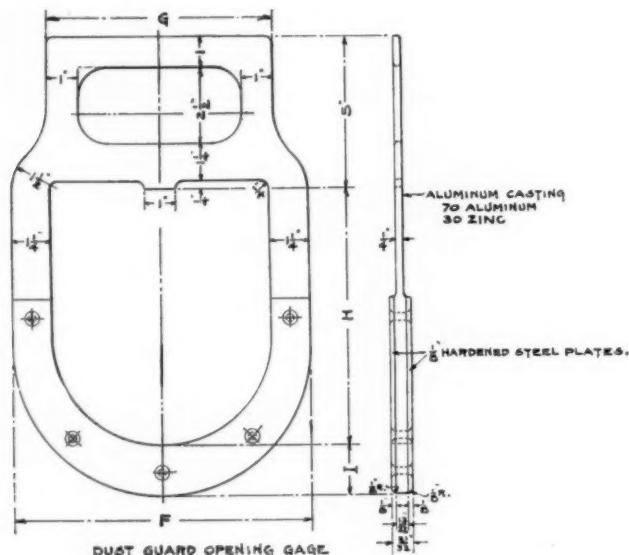


Fig. 4

same for all trucks of which the bolsters have separable center plates.

Another design of bracket is used for all bolsters in which the center plate is integral.

The thickness of the spring plank for the 2/C truck is $\frac{3}{8}$ in.; for the 2/D $7/16$ in.; and for the 2/E truck $\frac{1}{2}$ in.

The side frames are provided with bosses, over which the spring planks are set. The holes in the spring planks should be made to fit these bosses closely.

On the 2/C and 2/D trucks a 13 in. channel may be substituted for the pressed spring plank.

Since the instructions to this committee required that it present designs which may be made complete, the committee has included

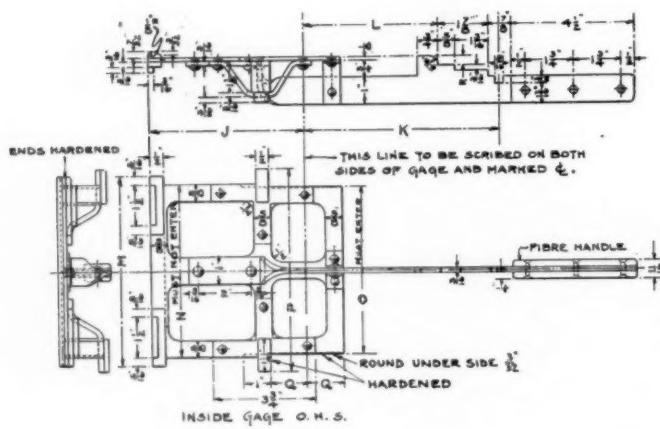


Fig. 5

what may be considered the simplest and most efficient details, in each case, and such which would involve the least amount of maintenance cost. It should, of course be understood that other details, of equal strength and entirely interchangeable, may be substituted, such as I-section brake levers, hollow brake lever spreaders, etc.

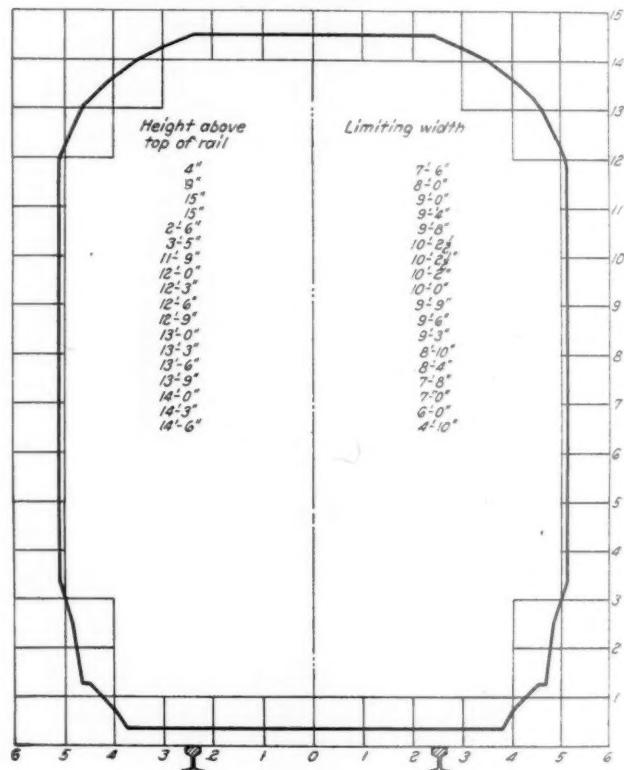


Fig. 6

which are submitted herewith, that they know is patented, we shall be very glad to have them advise the secretary of the association, or the chairman of this committee, in regard to the same, so that the necessary investigation can be made.

The Committee recommends that one or more cars of each of the types covered by this report, be built in the near future.

Specifications for A. R. A. Box Cars

1. GENERAL REQUIREMENTS: Cars, when delivered, shall be complete in all parts ready for service, shall conform to A. R. A. Standards, recommended practice and to the following specifications.

Where the A. R. A. Standards, recommended practice, design and these specifications permit options, there shall be a definite agreement between the builder and purchaser as to which of the optional details shall be used. They shall also agree as to method and place of inspection of cars and of material.

The purchaser shall furnish the builder all necessary information relating to paint, marking, lettering and stamping desired in addition to that covered by A. R. A. requirements for both material and completed car.

All lumber used shall be kiln dried.

All steel plates $\frac{1}{4}$ in. and less in thickness, pressed parts made therefrom and channel side sills shall include a content of copper of not less than 0.20 per cent.

2. AXLES: Journals and wheel fits shall be finished smooth and true to gage. Journals shall be burnished. The heat number of the axle shall be transferred from the black collar to the other end of the axle in the presence of the inspector.

3. SIDE FRAMES: The size of journal shall be cast on outer side of each steel frame in numbers not less than 1 in. high.

4. TRUCK BOLSTERS: The owners' initials and the car number shall be stenciled in letters and numbers not less than 1 in. high on one side of each bolster.

5. CENTER PLATE BEARING SURFACE: For center plates cast integral with truck bolster the center plate bearing surface shall be machine finished or ground. All center plate contours shall conform to limiting gages.

6. FUNDAMENTALS GOVERNING AREAS OF SECTIONS: Where such fundamentals are specified in A. R. A. Standards or recommended practice they refer to grade A material in proposed specification for carbon steel castings, which require a yield point not less than 29,250 lb. per sq. in. with an elongation, per cent in 2 in., of not less than 1,450,000-tensile strength. If Grade B material, having a yield point not less than 36,000 lb. per sq. in., with an elongation, per cent in 2 in., not less than 1,600,000-tensile strength is used a reduction of area of 12½ per cent will be allowed. Rolled or forged steel which meets the same yield point and elongation requirements shall have the same allowance for reduction of area.

7. Draft gear keys shall be quenched and tempered carbon steel forgings.

8. Rivet holes shall match and drifting shall not be allowed. Holes, which do not match shall be reamed. Rivets, after they are driven, shall completely fill the holes, and shall have heads of the proper shape lying tightly against the sheets or castings.

9. Flanging of sheets must be true to shape to provide close contact with contiguous parts.

10. Joints in superstructure and roof must be water-tight—Asphaltum paper about $1/16$ in. thick shall be placed between riveted joints of all-steel roofs.

11. Brake pipes shall have smooth edges free from fins and burrs. A thin coat of graphite grease shall be applied to the male threads only and care shall be taken to keep the grease from the inside of pipe and fittings. Connections shall be tested under 100 lb. gage pressure, using soap-suds to determine leaks. The completed brake installation shall be finally tested to determine proper working and absence of interferences.

12. All metal parts shall be free from scale and rust and thoroughly clean before they are painted.

13. Metal in contact with wood or metal and where not accessible after assembling must be covered with one coat of thick paint, red lead lute or lamp black lute.

14. Trucks (except wheels, axles and parts contained in journal boxes) and underframes shall have two coats of paint, the first preferably of freight car color and linseed oil and the second A. R. A. black paint.

15. Two coats of approved paint shall be applied to the outside of the superstructure and one coat to the inside of steel sheets. All-steel roofs shall have two coats of paint on each side.

16. The joints between floor boards and sheathing or lining shall be carefully filled with an asphaltum or similar compound which will not be brittle at 0 deg. F. and will not flow at 150 deg. F.

17. White lead paint shall be used for all stenciling.

The members of the committee are: W. F. Kiesel, Jr. (chairman), mechanical engineer, Pennsylvania System; A. R. Ayers, assistant general manager, New York, Chicago & St. Louis; C. E. Fuller, superintendent motive power and machinery, Union Pacific; J. C. Fritts, master car builder, Delaware, Lackawanna & Western; C. L. Meister, mechanical engineer, Atlantic Coast Line; J. McMullen, superintendent car department, Erie Railroad; T. H. Goodnow, superintendent car department, Chicago & North Western; John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe; W. O. Moody, mechanical engineer, Illinois Central; J. A. Pilcher, mechanical engineer, Norfolk &

Western; H. L. Ingersoll, assistant to president, New York Central; W. H. Wilson, assistant to vice-president, Northern Pacific; F. W. Mahl, director of purchases, Southern Pacific; W. H. Winterrowd, chief mechanical engineer, Canadian Pacific, and G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific.

Discussion

W. F. Kiesel, Jr. (Penn. System): After the heading "Fundamentals: Center Sill Area," add the following: "There has been a great deal of discussion in connection with that in the last two or three years and the committee is now unanimous."

Mr. Kiesel: Since coming to Chicago, quite a number of people have raised the question as to whether it is intended that we recommend permitting interchangeable ends. Possibly this reading does not give the intent of the committee clearly. The intent is that the designs shown on the drawings for single sheathed and double sheathed cars are not of the same width and therefore are not strictly interchangeable as drawn, but it was meant that corrugated ends or any other kind of ends may be substituted since that is already a standard of the Association.

There is no intention of abrogating the rule which is now in the manual relating to corrugated ends. We may be able to make this a little more clear by making the clause read as follows:

"Car ends should not be made interchangeable between single and double sheathed cars. Other ends preferred and applied by individual railroads should be equal in strength, serviceability and interchangeability with those shown."

I believe I could say for the committee that it should be substituted for the reading we have here, and I think it will clarify that point which so many have called our attention to.

I would like to refer again to the question of the ends. It is the full intent of the committee that the rule which is now in the manual in regard to corrugated should remain there and should govern.

Chairman Coleman: The secretary has two communications which he will read.

Secretary Hawthorne: The first is a communication from the T. H. Symington Company, signed by C. J. Symington, president, dated June 18, 1923, and is as follows:

"We have noted the paragraph in the advance copy of the report of the A. R. A. Committee on Car Construction, reading as follows:

"The combined bolster filler and backstop casting shown in the design is recommended for use, provided the owner or owners of patents on the combined bolster filler and backstop casting, permit the free use of the combined bolster filler and backstop casting without restriction or any obligation whatsoever, by any railroad or car owner whose cars are used under the jurisdiction of the A. R. A. or its successors."

"As we are the owners of existing patents and have also numerous pending applications for patents on the combined bolster filler and backstop castings shown in the drawings accompanying the above report, we wish to assure the American Railway Association that our waiver of patent rights as contained in my letter to you of May 19, 1921, constitutes an absolute and unrestricted license to all railroads and car owners whose cars are used under the jurisdiction of the A. R. A. or its successors, to make or have made and to use the combined bolster filler and backstop castings as shown in these drawings, with either the vertical or horizontal yoke attachments, without further license from this company under any patents now owned or controlled by us or that may in the future be issued upon any pending application now owned or controlled by us."

The Secretary: I have another communication signed W. F. Kiesel, Jr., chairman of the Committee:

"The arrangement of side frame with separate journal box, shown in the report, is covered by my patent No. 1,433,380, dated October 24, 1922. Another patent, serial No. 602,138, covering the construction of the central portion of both frames shown in that report, is now pending, on my application.

"I hereby agree that designs adopted by the American Railway Association, either as standard or as recommended practice, and subject to either, or both, of the aforesaid patents, may be built by, or for, any railroad or car owner whose cars are used under the jurisdiction of the American Railway Association, or its

successors, without payment of any royalty, or other obligations, on account of said patents."

F. H. Hardin (N. Y. C.): The Committee on Car Construction is to be complimented for the detail in which it has presented this report as it, without question, involved a tremendous amount of work. I have, in the short time that has elapsed since this report was distributed, run through the report and made a number of notations of miscellaneous details that would, I think, require considerable time to discuss and which discussion would probably be profitable.

I realize, however, the hopelessness of undertaking to discuss all minor details and yet I hardly see how it will be possible to cast an intelligent vote without full detailed consideration of all such matters.

There are a few items which I choose to call fundamental to which I wish to draw particular attention. I discussed in a general way some of these matters with Mr. Kiesel yesterday afternoon and he feels that while there may be a difference in interpretation of the words, the fundamentals are not up for discussion. I must take issue with Mr. Kiesel on that point.

I maintain that anything included in this report by omission or commission or inference is subject to discussion and that it is the duty of this convention to discuss fully any points about which there is a doubt.

I would draw attention to the brake arrangement on the two cars submitted. A plan of the brake is given in one drawing presented with the report and on the brake cylinder lever, dimensions are marked *A* and *B*. Immediately thereunder is a notation "Dimensions *A* and *B* to be adjusted to suit desired brake power." On the detail drawing, however, the brake cylinder lever is shown in the upper left-hand corner and includes dimensions *A* and *B* with a note reading "Cylinder levers are proportioned for a total brake power of 31,000 lbs. per car with a cylinder pressure of 50 lbs. per sq. in." This will give in one case a braking power of approximately 72 per cent, and in the other a braking power of approximately 77 per cent. It would appear proper to eliminate those dimensions by making notation thereon similar to the one appearing on the preceding page, or else state that the dimensions should conform to A. R. A. standard practice, which is 60 per cent.

Bottom-Supported Door as an Alternate

Doors of the top-supported type are shown for both cars. Our experience has been that the advantage lies with the door supported at the bottom. It is difficult to operate a freight car door which is hanging from the roof unless the car is alongside the platform. The door supported from the sill, which is the foundation of the car, can be more readily operated and has a better support. It may have been intended that an alternate could be used in this case, but no specific statement is made to that effect. We feel that the drawing involved should bear a notation that a bottom-supported door can be applied as an alternate.

Mr. Kiesel suggested last night that it would be in order to make a motion to the effect that the committee be instructed to submit also a bottom-supported door. I believe that a notation on the drawing would fully cover the matter without the necessity of a complete design.

The drawing showing coupler release details apparently does not include an alternate—whether one was intended or not I do not know. The release rigging shown is one which, while I have not time personally to check it, I understand will not operate the type E' coupler. I think this drawing should also bear the notation that other types of rigging conforming to safety appliance standards will be accepted as alternates.

The statement is made in the body of the report that two designs of roof are shown which in the opinion of the committee represent the best of their respective types.

The outside metal roof shown apparently has inclosed car-lines of the same section as the U. S. R. A. carlines, which, as a good many of you know, have given considerable trouble. Car-lines in this case have been more firmly attached to side plates than in the U. S. R. A. car, but the breakage has been through the carline itself and not through the attachment to the side plate. The same situation applies to a certain extent in the riveted-up steel roof. Carlines used are of a lighter construction than the U. S. R. A. carlines. In addition to this, the riveted-up type of roof involves apparently an excessive number of vertical rivets in the roof, which we consider objectionable.

Vertical rivets represent possibilities for leaks in a roof, which could not occur with horizontal rivets. A small content of copper has been specified in the roof sheets. This will no doubt retard but will not prevent corrosion.

It is no doubt also the intention of the committee to permit substitution of other designs, but it is felt that it should be so stated specifically on the drawings. So far as these matters are concerned it may be considered that they are partially covered at least in the statement in the report reading as follows: "The intent of the committee is to make designs that will establish fixed conditions permitting the use of detailed designs standardized by the Association or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts or groups are the equivalent in strength, service, safety of and interchangeable with the standard part or group of parts replaced."

That statement while appearing in the report is not a part of the specification, and will be the source of considerable argument to determine when a substitution is equivalent in strength, in service, in the safety of and interchangeable with the standard part or group of parts replaced.

Take for example the question of roofs. It should appear that it might be reasonable to permit the use of any outside metal roof or any riveted steel roof if conforming to the general dimensions shown in the drawing, and if that should be agreed upon it should appear on the drawing itself and therefore become a part of the specification.

Mr. Kiesel referred to the question of corrugated ends. An end is shown in the drawing for these cars which I believe is heavier, more expensive, weaker and occupies more room or takes up more space than the corrugated steel ends. The recommended practice of the Association adopted in 1914, revised in 1920, specifically mentions the use of corrugated steel ends and on the drawing showing the end of the car we believe should appear the notation that the recommended practice of the Association of 1914, revised 1920, is a part of this specification.

The question of the center sill area, of course, has occupied considerable time and discussion in the past. It may or may not be up for discussion at the present time, but it appears that a lot of material has been added to the center sill for the strengthening of the car and no allowance made for the effect of draft gear capacity. A 150,000 lb. capacity draft gear of approved make, presumably makes the car safe from the standpoint of resistance to shocks. The use of a heavier capacity draft gear to relieve the sills from shock will reduce the ultimate blow to the sills more than can be achieved by adding 6 sq. in. in section area to the sills.

These are the fundamental matters that I had in mind, and, as stated in the beginning, considerable time could be devoted profitably to the discussion of a large number of miscellaneous details, but the time is too short and none of us I believe have had full opportunity carefully to review all the details involved.

Corrugated Ends Recommended

I believe the presentation of this design is one of the most important subjects that has come before the Association in years. There is no haste that I see. There are no exigencies that existed such as confronted the standards of the United States Railroad Administration in their car design, and we are inclined to feel that more time for deliberation and study of this matter should be given, not only to the members of the Association, but possibly to the members of the committee in answering some of the questions which have been raised and which no doubt will be raised in the future. We have no desire whatever to tear down what this committee has built up and we do not take the position of opposition to the policy of a standard car. Quite the contrary is the case, because the New York Central early in 1920 adopted the U. S. R. A. car standards as their own and is using those standards to this day with certain modifications, and that move was made largely to facilitate the work the A. R. A. had undertaken in designing a standard car. This, I believe, was the first definite move in the direction of the adoption of a standard car.

In view of these things, Mr. Chairman, I move that the report of the Committee on Car Construction be accepted as a report of progress only.

L. K. Silcox (C. M. & St. P.): The Car Construction Committee has done a great deal of work and we should help them with any thoughts we have at this time. An effort has been

made to go into this important matter simply from the standpoint of our own experience and not with any desire to tear down the work of the Committee or with any idea of discouraging the principle of the standard car.

Side Doors—The door posts for single sheathed box cars are formed from angles providing an overlap for the door of only $1\frac{1}{2}$ in. while the Committee on Car Construction in 1920 recommended a minimum lap of $2\frac{1}{2}$ in. See circular letter No. S III-189. A 4-in. Z-bar, which is commonly used in this type of car, forms the desirable overlapping of the doors and also furnishes adequate stiffness against bulging as compared to angle iron door post in the submitted design.

End Doors—The committee recommends that end doors be eliminated. The mechanical department of the St. Paul has been forced to install a small end door, 8 in. by 14 in., in its latest box car. This door is used for loading lumber and is made purposely small to prevent pilfering. We would recommend that the committee consider incorporating a small end door in the standard box car design for railroads desiring to perpetuate the use of end doors.

Fundamentals of Center Sill Area—It is recommended that the area of center sills for cars not equipped with roofs have a minimum of 30 sq. in., while cars equipped with roofs should have a minimum area of 28 sq. in. It is inconsistent to specify two different areas of center sills, inasmuch as both open and closed types of cars are designed with sides of sufficient strength to carry the load. The center sill is primarily designed for buffing and our recommendation would be to specify a minimum area of center sills for all types of cars of 28 sq. in.

Standard Box Cars—(a) The side frame construction for single sheathed box cars is changed from the U. R. A. type of car, which had a Howe truss form of side framing, to a Pratt truss. By making this change the stresses in the members are approximately as follows for 40-ton cars: Door posts changed from 5,600 lb. compression to 0, except for a small load due to the weight of the roof. In the diagonal brace next to door post, the stresses have changed from compression to tension. Intermediate post stresses are changed from 22,400 lbs. in tension to an equal amount in compression. The diagonal brace adjacent to the bolster is changed from 28,400 lbs. compression to an equal amount in tension. The side post at the bolster is changed from 3,600 lbs. compression to 26,200 lbs. in compression. It will be noted that the door post has ceased to function as a vertical load carrying member. The intermediate posts and braces remain unchanged as far as the stresses are concerned, but the direction of the forces have been reversed. The side post at the bolster is most severely affected because the load carried by the diagonal brace adjacent to it is also imposed upon it.

Were the Howe truss to be employed by the Car Construction Committee, it would not involve any additional frame parts. The only reason why the bolster post shows a relatively higher unit stress in the instance of the Pratt truss, recommended by the committee, is that all the members of the frame are not employed to do useful work in load carrying; whereas, in the case of the Howe truss, which has been almost universally employed by the railroads that have built single sheathed cars in the past, each unit of the side frame sustains a portion of the load.

One of the most important commodities carried in box cars is grain. From calculations, it has been found that the pressure of wheat against the side of the car produces a bending movement of 6,200 in. lb. per lineal foot. The combined stresses derived from the vertical and bulging loads in the bolster post and diagonal brace adjacent to it in the 40-ton car is 21,300 lbs. and 27,300 lbs., respectively. Realizing that the grain will occasionally be heaped up in one end of the car, bulging stresses in extreme conditions will be considerably higher. It is felt, therefore, that these two members in particular are too highly stressed. The diagonal brace would have to be increased in strength regardless of what type of truss is used.

We would recommend that the side frame be redesigned, taking into consideration the bulging stresses produced by grain and other commodities; also designed so as to be able to substitute structural shapes for the pressings shown, in cases where it is desired to do so. The pressed steel posts and diagonal braces should be specified interchangeable with the rolled shape sections.

Cross Bearers—The cross bearer is located at the intermediate side post. It is our belief that better construction would be obtained by placing the cross bearer at the door post. This

would decrease the free span of the center sill and reduce the load which is to be carried by the center sill and transfer it to the cross bearer, thence to the side framing.

End Construction—Preliminary calculations indicate that the total section modulus of end post and end braces is approximately 13. The total section modulus of end construction used by some roads is 20.6. It has been proved in service that the minimum requirements for a built-up end construction includes two 3-in., 6.7-lb. Z-bars and two 5-in., 11-lb. Z-bars having a section modulus of 14.4. We recommend that an alternate for the pressed shape construction be made up of structural members. Also provision should be made for the use of pressed steel ends. In this connection, with pressed steel ends, a specification should be made up to give the minimum requirements so far as necessary section modulus is concerned.

Carlines—Carlines applied to the U. S. R. A. cars have proved in operation to be entirely too weak. A large percentage are breaking near the side plate. In some instances the entire roof has caved in, due to broken carlines. If this carline is to be used in the new design, it will be necessary to supplement it with diagonal braces or other suitable means.

Purlines—Purlines are apparently omitted in the roof construction. If a flexible all-steel roof is used, it is necessary to have purlines, but the construction does not make any provision for them.

Inside Dimensions—The steel-frame car and the all-steel car do not have the same inside width. It is desirable that the two be identical, otherwise shippers will discriminate against the smaller car.

Center Plate Height—The center plate height on the U. S. R. A. car was established at $25\frac{1}{4}$ in. This height was ideal for a 12-in. center sill section, as the center sills provided an ideal column without setting up any secondary eccentric stresses in the structure from buffing shocks. I would recommend that the U. S. R. A. established center plate height of $25\frac{1}{4}$ in. be used in place of $26\frac{1}{4}$ in.

Center Sill Construction—The special rolled section for center sills seems objectionable from a practical standpoint on account of being unsymmetrical and it probably would be hard to procure in small quantities for repairs. Considerable cutting of flanges will have to be made to accommodate the draft gears and this operation may retard the production in building new cars. Some roads favor a 15-in. built-up center sill construction because it is stiffer without adding weight. I would recommend that the center sills be reconsidered by the committee and alternate designs made up for standard channel section construction.

Front Draft Lug—This could be redesigned to eliminate coping the top and bottom flanges of the center sill, thus avoiding extra work and saving at least 6 in. of material.

Push Pole Pockets—The designs for the two types of cars are superfluous. These details could be eliminated.

Bolster and Cross Bearer Diaphragms—These are made with open corners. It would be desirable to have closed corners, as it would not cost any more to fabricate and considerable strength would be added.

End and Side Lining—The lining of the steel framed box cars is shown to be $5\frac{1}{4}$ in. face, tongued and grooved. Our experience has been that it is not possible to obtain a full $5\frac{1}{4}$ -in. face from lumber 6 inches wide, after being kiln dried. This dimension should be changed to $5\frac{1}{8}$ -in. The thickness of the end lining, which is shown to be $1\frac{3}{4}$ -in., is insufficient; it should be $2\frac{1}{4}$ -in.

All-Steel Box Car—Time has not permitted a study of this design. But we believe that the side posts should also be designed to resist bulging for this type of car. The same thing is true of the end construction.

Truck—(a) The truck side is apparently an entirely new design. Past experience seems to indicate that it is necessary to have the web members of the frame uninterrupted and of uniform section. Introducing other members joining directly or in the immediate vicinity of the web members, such as the bottom portion of the design submitted, or brake hanger brackets, has caused shrinkage cracks. Before this truck side is adopted to any large extent, it would be very desirable to have it thoroughly tested out in actual service.

It seems to be the desire of the committee to use identically the same contour of truck sides for frames having separate and integral journal boxes. There appears to be no particular advantage in this as separate patterns would have to be made for each design. A better and lighter casting for the integral truck side could be obtained than that proposed.

Journal Box—A new type of journal box is submitted, which is not interchangeable with the present standard inasmuch as the bottom lugs for the journal box bolts are eliminated. The contour of the top surface is also changed from the old standard to make the box fit into a recess in the truck side. The top surface of the box is ribbed, thus reducing the bearing surface. If the journal box bolts become loose, considerable wear will take place on these ribs. By adopting a new journal box without bottom lugs, the standard arch bars cannot be used. Neither can truck sides having bottom tie straps, now on the market, be employed to advantage. There are still a number of roads which object to having cast steel in the truck side construction and, therefore, this should be taken into consideration when designing both the truck side and the journal box.

Truck Springs—It is a well-known fact that the present truck springs are unsatisfactory. It would have been desirable, when submitting a new design of truck side and other details to make provision for new truck springs.

Brake Application—No improvements have been recommended in connection with the hanging of the brake beams to further their safety. The truck brake rigging as ordinarily used at the present time is one of the weakest points in the car, and some improvement in applying these details should be looked for.

Safety Hangers—The three-point suspension brake beam safety spring is recommended. This is a patented device and it would be desirable to submit a design for application of a four-point suspension which would form a better safety device than the three-point suspension.

Spring Planks—The details indicate that a rigid spring plank is employed. A number of roads are using the flexible type of spring plank. This design should be considered and made interchangeable with the rigid type.

Conclusion—The above criticism is not made to discredit the valuable work done by the Committee on Car Construction. A sincere effort has been put forth to design a car having maximum strength with a minimum weight and the committee has succeeded to a large extent. But in its anxiety to obtain the lightest possible car, probably some sacrifices have been made in the strength. It is, therefore, suggested that the designs of box cars and trucks, before being submitted to a vote by the members of the A. R. A. should be referred back to the Car Construction Committee for reconsideration. It would be desirable to have the committee take into account experience, based on practice, herein mentioned and to judge the matter in its broadest aspects in order to obtain a variety of interchangeable parts so that the various railroads could adopt, with the car body, either a structural construction or a pressed-shape design and still maintain interchangeability.

Mr. Kiesel Replies to Messrs. Sillcox and Hardin

Chairman Coleman: Before there is any further discussion, Mr. Kiesel would like the opportunity of replying to Mr. Sillcox and Mr. Hardin.

Mr. Kiesel: We, of course, like to have as much discussion in regard to this matter as possible, but the committee was tied down to the A. R. A. standard and recommended practice.

Mr. Hardin made the statement that I told him that the fundamentals were not subject to discussion. What I intended to say was that the fundamentals which are now your standard and recommended practice are not open for discussion. They should have been discussed and settled at the time when they were adopted.

Both Mr. Hardin and Mr. Sillcox are reopening such matters as 30 sq. in. of center sill area, which is your standard; heights of center plate, which you have adopted as 26 $\frac{3}{4}$ in., having been changed from 27 $\frac{1}{4}$ in. The Car Construction Committee on the basis of the 30 sq. in. area for all cars with the exception of house cars now recommends a reduction to 28 sq. in. for house cars, which was unanimously adopted by the Car Construction Committee after a full investigation, which extended over two years.

As far as the recommendations of Mr. Sillcox to use the U. S. R. A. center sill height, the committee did not adopt that for the reason that it gives an unbalanced center sill section and requires a heavier car for the 40-ton car, and it necessitates larger trucks and hampers to a great extent the construction of the bolster. It also gives a distance from the top of the rail to the bottom of the side frame with a cast steel side frame of less than 4 $\frac{1}{2}$ in. when the wheels are worn, and 4 $\frac{1}{2}$ in. the committee feels is the minimum that should be allowed.

In regard to the question that was raised by Mr. Hardin in regard to brakes, our intent was to leave the question of braking power

to be handled by the Committee on Brakes and Brake Equipment. Therefore, we will eliminate the dimensions of brake levers which unfortunately were overlooked when the committee changed the general plan of making that report.

As to the top hung door, the A. R. A. doors, I believe, are all top hung and we followed the A. R. A. standards in that respect. If a large number of the A. R. A. members desire the design of a bottom hung door also, the committee can very readily make such a design but it would not amount to anything if we stated on the drawing that a bottom hung door could be substituted.

The work assigned to the committee was to produce a car design, which we have done. We are submitting to you a design, which, per pound weight, is the strongest box car that has ever been built in this country. That is our firm belief. By refinement of design we have eliminated a lot of weight.

The subject of roofs has been criticised. The report states that any kind of a roof may be substituted, whichever is preferred by the railroad. Each railroad can determine for itself whether the roof that it wants to substitute is the equivalent of what the committee shows. If it cannot do that, it can readily be referred to the American Railway Association and I have no doubt the association can advise them.

Doors with 1 $\frac{1}{2}$ in. overlap were referred to by Mr. Sillcox. The larger dimension refers only to old doors and especially to old wooden cars. In the rules for new cars that requirement has been eliminated on account of having something else that answers the same purpose.

In regard to the omission of end doors, ultimately the end doors ought to be omitted, but we did not mean in our recommendation that they should be taken off now, but if used they should be maintained just the same as side doors.

The center sill area is the association's standard. Therefore the committee had no option, but had to use your standard.

Now we come to the Howe and Pratt trusses. We can not agree with the stresses that Mr. Sillcox gave. The stresses in the side frames of those cars were checked up in three separate drawings, and there are no stresses in that truss such as he gave. We would be glad to go over the matter with him and check up with him as to the stresses. Furthermore, in the truss that he showed, which is used on the St. Paul, the diagonals are in compression. In the truss that we adopted the diagonals are in tension. There is no reason why it is preferable to put diagonals in compression rather than in tension. In bridge building they use both the Howe and the Pratt trusses and if properly designed either one is satisfactory.

Concerning the pressed steel ends, Mr. Sillcox asked for the specification for the ends. This is already in the manual.

Mr. Sillcox mentioned a great many other things which are more or less matters of opinion. We would be very glad to have him submit them to the committee, and we would be very glad to go over them and see whether there is anything that would help us in making a proper design. He mentioned among other things that we showed tongues and grooves. Among A. R. A. practice you will find that you can use either tongue and groove or ship lap.

Further, you will find that the width of the boards given in the A. R. A. standards as 5 $\frac{1}{4}$ in., and we had to use the 5 $\frac{1}{4}$ in. wood; there was no option. If he desires that changed to 5 $\frac{1}{2}$ in. he ought to call attention to it in connection with the diagrams of lumber shown in the A. R. A. standards; these have been standard for a good many years.

In regard to journal boxes, he objects to the separate journal box because it is different from the present standards. It is not our intent to substitute this journal box for the present standard.

The Car Construction Committee did not intend and does not intend to ask you to eliminate the present standards in favor of the new proposed standards, because we believe that after you find out that these trucks that we submit to you now will show approximately 500 lb. less weight per truck with the same capacity than those you are using now, you will want the latter.

Three-point suspension for the brake on the truck is put there to complete the truck design. We do not yet know whether we will be subject to a patent in that connection. We have clearly intimated in two or three places that any alternate, whether any part or group of parts, may be substituted providing it is the equivalent, and if an engineer can't determine whether it is the equivalent, a specification can be made to show that.

The final statement of Mr. Sillcox was that we probably sacrificed strength in order to obtain light weight. I can assure you, and this has been checked in four drawing rooms by some of the

most competent designers in the United States, that the stresses are not in excess of what is commonly used in practice, and that the side frame and the strength against bulging—that is, the strength of the body of the car—is greater than the average car running today of the same capacity.

T. H. Goodnow, (C. & N. W.): Like the previous speakers, we have two or three pages of personal opinion on details of the standard car which I am not going to take up any time to present. I simply want to say a word in connection with the policy of this standard car.

As a member of the Committee on Car Construction I am offering no defense either for the committee or for myself.

I have attended most of its meetings and where I did not attend I was represented. All that is being brought up today is simply a rehash of what has come up in the committee in some shape or form. With the membership of about 15 on the committee I can appreciate the results of a progress report with some 400 roads expressing their individual ideas as to the final results of the standard car. I will leave it to you just to think it over seriously and if you don't agree with me when you come here next year and go along with your progress report I will miss my guess.

Speed Needed in Developing Standard Car

I think it is well known to most of us that there are certain issues working at the present time which make it very essential that speed be made on the standard car. I do not think it necessary for me to mention what those are, but nevertheless I think it would be very desirable if this association could at the earliest possible date adopt a standard car; in fact, I think it is necessary that it should do so.

If the door fixtures and the uncoupling levers and all of the other items annexed to the car, cause the objections, just leave them off and let us go along with the framing and the trucks, if we can. Let us at least get that far with the car.

Personally there are a number of items in connection with the details that I feel that the Chicago & North Western in building the cars from its experience can probably improve on, but at the same time, it will not affect the interchangeability of repairs and anybody that has that car can repair it with standard parts and we will accept it. That is the broad principle that we will all have to go on finally in the handling of the standard car.

I quite agree with the mention that was made of the administration carline, and also with regard to the end. I think the committee can very consistently change the wording at the end, which apparently is so confusing, and put there the wording of your standards as they were adopted under circular letter S III 159, July 19, 1920. However, I am not going into the details. Whether that appears or not, it is nevertheless your standard. What I want is to push the standard car just as fast as possible.

If anybody had sat through the deliberations of the Car Construction Committee in the past year in dealing with this subject he would fully appreciate that and I hope that any motion that prevails here will not slow up at least the starting of a standard car, because I know that it is important. Changes can be made in the standard car just as we have made changes in the various standards from time to time.

R. L. Kleine, (P. R. R.): I would like to know if it is the intention of the committee to submit the plans to the Eastern and Western Railroad Associations so as to know where we stand on the patents, if any, that exist on these cars.

Mr. Kiesel: We specified in our report that the intent is to get a report on all the various parts of the car.

Mr. Kleine: I understand that, but I didn't know whether you were getting a report from the two associations named or not. That is what I want to clear up.

Mr. Kiesel: Whatever the association directs us to do, we will be glad to do. My own opinion is that the question of patents should be handled by a separate committee. However, if the association directs us to look into the patent matter, we will be very glad to do that and take it up with both associations. We have taken up the question of truck side frames and bolsters.

From the report it would appear that after November of this year, with the letters that the association now has on file, the bolsters and side frames can be built by anyone without infringing on any patents, or paying any royalty. As far as the car itself is concerned, there may be some features that we are not aware of that may be subject to patent, but we have submitted a design complete, and I do not believe we ought to submit it to the Eastern and the Western Railroad Associations. In fact, it is not

worth while doing that until the association approves the car, for without this approval the car is useless.

As far as end construction is concerned, the standards of the association now permit corrugated ends, and the committee did not show that for the reason that corrugated ends are patented. Our intent was to show a design as free from patents as possible.

J. J. Tatum (B. & O.): Last night I put in considerable time studying the report and knowing what work is involved in undertaking to please everybody by getting together what might be called a standard car, one can appreciate the work that this committee has had to do. I think it has made a very good report.

Your criticism no doubt will be helpful, but I hope it will not retard the action enabling a sample standard car to be built. The only question that I have in connection with this report is, Why were not the M. C. B. standards made use of to the fullest possible extent in establishing this standard car? My reason for asking that question is that for a number of years we have been getting together various standards and these standards have been approved from time to time until today many of them have met all the requirements.

We have here before us in this report a new truck which I, myself, do not know anything about. I have never seen such a truck. I do not know what sort of work it will do. I do not know what the result will be, but I do know what the M. C. B. standard truck will do, and I do know there is a possibility of improving that standard without departing from any of its dimensions; that is, dimensions which would affect its interchangeability. I might say the same thing about the doors, and the uncoupling arrangement.

The Proposed New Trucks Should Be Tested

Mr. Hardin: There is no disposition in the motion which I made to delay progress. I do not believe it will. As a matter of fact I made that motion for the specific purpose of continuing progress on this report. It will not in any way alter the report as it stands; it will not amend it; it will not exclude anything that is included in there, but merely delay the final action as adoption of the standard of this association. In the meantime it will provide an opportunity for the construction of such cars and the trial of the trucks, which I feel should be done before the car is finally adopted.

Mr. Kleine: I can hardly see how, by accepting this report of the Car Construction committee as a progress report and laying it over for one year, we will expedite the standard car one iota. I think this committee has done excellent work as far as it has gone. It is unfortunate that we did not have the report before us a greater length of time in order to criticize it, but Mr. Hardin made the statement that he is in favor of the standard car and, as I understand it, he is also in favor of getting this standard car adopted as promptly as possible.

I would like to amend Mr. Hardin's motion to this extent: That the committee consider the objections raised and then submit its findings to letter ballot in detail; also authorize sample cars to be constructed during the year so that we will get a study from the manufacturing end as well as a complete review of the opinions of all the railroads of the association insofar as certain details of the standard car are concerned.

Mr. Hardin: I do not understand exactly what the amendment is. Is it to eliminate these details and are they to be specifically referred back to the committee?

Mr. Kleine: The details discussed are to be referred to the Car Construction Committee, as well as any other criticisms of the design, giving the members an opportunity to write the committee concerning those details. Then the committee would consider those as well as any subsequent criticisms and submit to letter ballot the result of its deliberations on these criticisms.

Mr. Hardin: I think I would much prefer to follow Mr. Goodnow's scheme and possibly eliminate for the time being some of these questions in dispute, and if that is done I am in a position to withdraw my motion. Mr. Goodnow refers to ends, roof, etc.

Chairman Coleman: As I understand it, it gives every man an opportunity to present his objections to any of the details in this standard car to the committee, which will take into consideration all of the objections and criticisms. Do I understand, Mr. Hardin, you have withdrawn your motion?

Mr. Hardin: No, sir. I shall be in a position to do this if we can proceed as Mr. Goodnow suggested. If the Car Construction Committee can do that I will withdraw the motion. As it stands,

the motion is before the house unamended and I cannot accept the amendment Mr. Kleine has proposed.

Mr. Kiesel: Mr. Hardin, do I understand you to say that if we eliminate the requirements calling for specific designs of end, roof, doors and so on that then you will withdraw your motion? That was the committee's intent anyway, and it will certainly put it on the drawing if you would rather have it there than in the specification.

Mr. Hardin: I am willing to put it either in the specification or on the face of the drawing. I prefer the face of the drawing, but if the committee feels that could not be done, I think it should be embodied in the specification itself. That would apply to the door, ends and roof. I believe the truck situation is already covered.

Mr. Goodnow: It is my idea to make definite progress and as the end is a standard we can simply change the report and accept that portion of the committee's report which refers to its design and embody in that the wording of the present A. R. A. standard. That will take care of the big part. The roof is entirely optional. You can use any roof desired under the committee's report. If the question of top and bottom hung doors and release rigging is going to tie up anything in the progress of this car I would leave them off for this year. I think that we can maintain the interchangeability of the trucks. The only thing that impresses me as being essential is the height and general dimensions of the truck. We don't have to have a bolted box. If I want to use the bolted type of truck frame under my car so long as I make it to the general dimensions I can do it.

Mr. Tatum: Suppose a railroad should elect to put in the existing M. C. B. standard truck, is that permitted?

Mr. Goodnow: No.

Mr. Tatum: Then the truck that we have been using for years and years, working on to standardize, goes into the scrap heap.

Mr. Goodnow: I don't think you understand me. The standard height of the truck has been changed.

Mr. Kiesel: It was changed a year or two ago.

Mr. Tatum: Do you know anything about a short box bolt?

Mr. Goodnow: I don't think that is the question. If you want to put a frame under my car that has the short box bolt that you refer to, if my car has a 5 ft. 6 in. wheelbase, if my height is the A. R. A. standard, you can substitute your short box bolt for my type or any other type of truck frame that I have used on the standard car.

Mr. Tatum: You are asking me to run over my railroad a truck that I don't know anything about.

Mr. Goodnow: I am talking just the other way.

Mr. Tatum: Can I use an A. R. A. standard truck under a new car that I am building today?

Mr. Goodnow: What do you mean by A. R. A.

Mr. Tatum: I mean the M. C. B. standard truck as it exists today.

Mr. Goodnow: Is there such a thing?

Mr. Tatum: I have been told that there is.

Mr. Goodnow: It is only the height and wheelbase. I don't know of a design that is standard.

Mr. Tatum: Your Truck Committee certainly reported a design and it was approved by letter ballot; at least I have been credited with being on the committee approving it.

Mr. Goodnow: Well, I do not know it if there is.

Mr. Kiesel: The standard height of truck today is 26 $\frac{1}{4}$ in. Some years ago the standard height was 27 $\frac{3}{4}$ in. In order to see how much it would affect those trucks I had 100 trucks measured, taken from under cars. The height varied from 26 in. to 27 $\frac{1}{2}$ in. and any one of those trucks could readily be lowered to the 26 $\frac{1}{4}$ in. height. Most arch bar trucks now have a two-inch plank under the springs and if you take that out you have pretty nearly the present standard height of 26 $\frac{1}{4}$ in.

Mr. Tatum: I am not talking about dimensions, but suppose I elect to use an ordinary arch bar truck on 1,000 cars, would I be permitted to use the arch bar truck under that standard car?

Mr. Kiesel: We have not presented an arch bar truck. We have only presented cast steel side frames. You can use the old arch bar truck in connection with the new bolsters which we have.

Mr. Tatum: Then I can put the existing M. C. B. standard arch bar truck in use?

Mr. Kiesel: You can in accordance with the way the rules now stand and our report does not change those rules.

Mr. Tatum: That is all I want to know. I will vote for Mr. Kiesel's report with that understanding.

Chairman Coleman: Mr. Hardin, do you withdraw your motion?

Mr. Hardin: I will withdraw my motion and I want to make a motion in this form: First, that on the drawing included with the report of the Committee on Car Construction and entitled, "End Sheets," the following notation be made: "A. R. A. recommended practice adopted 1914, revised 1920, is a part of this specification."

Second: On the drawing accompanying this report which is entitled, "Coupler Release Details," the following notation be made: "Any other type of release rigging conforming to the safety appliance laws may be substituted as an alternate."

Third: On the drawing entitled "Steel Frame Door Arrangement," the following notation be made: "Door of bottom supported type may be used as an alternate if conforming to general dimensions."

Fourth: On the drawing showing outside metal roof, eliminate the note reading "Outside metal roof of manufacturers' designs must be made to suit dimensions shown and be interchangeable," and substitute the following notation: "Any outside metal roof may be used as alternate if conforming to general dimensions shown."

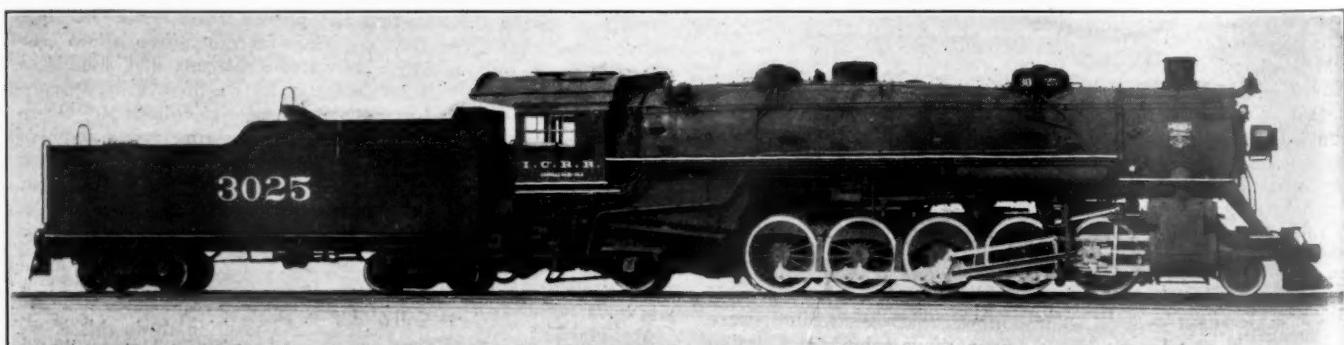
Fifth: On the drawing showing roof sheets of all-steel roof the following notation be made: "Any design of riveted roof may be used as alternate if conforming to general dimensions."

On the drawings showing proposed design for standard trucks, Classes 2-C, 2-D and 2-E, Types W and Y, the following notation be made: Any truck of proper capacity conforming to the A. R. A. standard dimensions may be used as alternate."

Mr. Kiesel: I can say for the Car Construction Committee that we can accept all of those notations because they conform closely with the intent of the committee in having this a car on which alternates can be used, and this merely makes it a little more specific than what we now show.

(The motion was duly seconded and carried.)

The report of the committee, with the amendments submitted by Mr. Hardin, was put to a vote and was accepted.



Illinois Central Mountain Type Locomotive, Built by Lima Locomotive Works

The History of Locomotive Development

Ninety Years of Unceasing Effort By Railways to Utilize Increasing Capacity and Economy

By S. M. Vauclain*
President, Baldwin Locomotive Works

AS FAR AS IS KNOWN, the first vehicle to be actually propelled by steam was a gun carriage built by Nicholas Cugnot, in Paris in 1771, while the first locomotive designed to run upon rails was built in 1803 by Richard Trevithick, a name that is still associated with the locomotive industry in England; a name that has received distinction as well in Egypt and Japan. Strange to say, the first successful effort in locomotion by steam in America was the Oructor Amphibolis, constructed by Oliver Evans in the city of Philadelphia in 1804. Mr. Evans' shops occupied the ground on which the United States Mint now stands; a site now surrounded by the buildings of the present Baldwin Locomotive Works. This locomotive was really a dredging scow. In order to get it from the factory to the river it became necessary to use it as a locomotive that would operate on the streets and without rails to guide it. Its performance was successful, but its utility questionable. Even at that time Mr. Evans realized the advantage of using a high steam pressure and expanding it in the cylinder so as to obtain some greater economy in its use.

It would be useless to attempt to trace the development of the locomotive in foreign lands. Mention should be made, however, of the first locomotive with a horizontal multitubular boiler, built by Seguin in France in 1827; and also of the famous Rocket, constructed in England by George Stephenson in 1829.

This locomotive was awarded the prize in a contest on the Liverpool & Manchester. It was the first locomotive to combine three basic features which are still universally employed, viz., a horizontal multitubular boiler, pistons directly connected to the driving wheels, and the use of the exhaust steam, which was discharged up the stack, to furnish a draft for the fire, and thus make possible the generation of large quantities of steam in proportion to the size of the boiler.

The first locomotive to be used in the United States was built in England and was named the Stourbridge Lion. It made a few trips on the Delaware & Hudson Canal Company's road at Honesdale, Pa., in 1829, but was considered too heavy for the track and bridges, and was soon withdrawn from service. The first locomotive actually built in America was the Tom Thumb, designed by Peter Cooper, a merchant of Baltimore, and used experimentally on the Baltimore & Ohio in 1830. It was about the size of a hand car, but it demonstrated the practicability of steam as a motive power. Then came the Best Friend, the first locomotive built for commercial purposes in this country, constructed in 1830

at the West Point Foundry in New York for the South Carolina Railroad. This engine was very successful for about seven months, when its boiler exploded, because the fireman became annoyed at the blowing-off of steam at the safety valve and weighted down the lever to ease his mind.

Old Ironsides was built by Matthias Baldwin and put in service in 1832 on the Philadelphia, Germantown & Norristown. Its weight was five tons. It was built under great difficulties. Its operation, all things considered, was very successful. It was quite a while before the officers of the company would permit this locomotive to go out in the rain—on rainy days horses were used—but one day it was caught out on the rails when the rain descended, and proved its utility to operate under such discouraging circumstances. The American locomotive has been out in the rain ever since. It will be noted that Old Ironsides had its driving wheels ahead of the firebox, with one large pair of carrying wheels supporting the front end of the engine. This added greatly to its adhesive qualities.

The further development of the locomotive by Mr. Baldwin led him to introduce a four-wheeled truck, and in this design the driving wheels were placed behind the firebox, which materially reduced the adhesion for traction purposes. The truck had first been used by John B. Jervis in 1831, and it provided the flexibility of wheel-base so essential to locomotives that operated

on the sharp curves and uneven tracks of that period.

The engineers of that day seem to have realized the benefit to be derived from high pressure steam, and when Mr. Baldwin introduced ground metallic joints in place of canvas and red lead joints for steam pipes, he opened the way for those who were to follow him in future and employ still higher steam pressure.

About this time the Norris Locomotive Works was established. Mr. Norris succeeded in building a locomotive of the same total weight as Mr. Baldwin's engine but of greater hauling power, by using a four-wheeled truck and placing the driving wheels in front of the firebox, so that a greater portion of the weight of the engine was utilized for traction. The next logical step in locomotive development in order to gain power was to use two pairs of driving wheels, placing one pair in front of the firebox and one behind it. This was done by Henry R. Campbell in 1836, who designed the first American (4-4-0) type locomotive, and had such a machine built by James Brooks of Philadelphia. This locomotive had no equalizing beams between the two pairs of driving wheels and, therefore, did not perform very satisfactorily. In 1837, however, Garrett & Eastwick of Phila-

*Mr. Vauclain, because of the serious illness of his wife, was unable to attend the meeting. The address was read by Vice-president Grafton Greenough, of the Baldwin Locomotive Works.



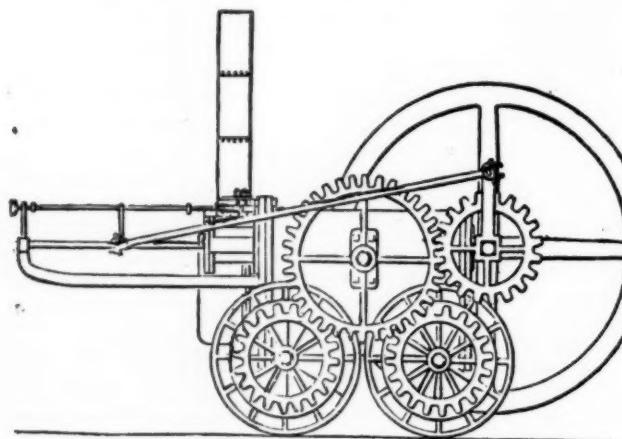
S. M. Vauclain

delphia built a locomotive for the Beaver Meadow Railroad, and introduced an equalizing bar between the two pairs of drivers, which device was patented by Joseph Harrison, Jr., who later became a member of the firm known as Eastwick & Harrison. Quick to perceive the value of this device, Mr. Baldwin was so pleased with it that he purchased from Eastwick & Harrison the right to use and apply it to all the locomotives he might thereafter build.

Rigid Wheel Base Introduced by Ross Winans

Mr. Baldwin, ever aggressive, felt that for moving heavy traffic which the railways then were called upon to handle required locomotives of greater power than any previously built. He conceived the idea of a flexible beam truck which would enable him to build locomotives with six coupled wheels. Such locomotives were put in service in 1842, and in the year 1846 had grown into a design using eight coupled drivers, the first two pairs being combined in the flexible truck. The largest locomotives of this type weighed about 30 tons. Ross Winans, of Baltimore, in this same year produced a locomotive with four pairs of drivers coupled, but very compactly grouped and held in a rigid frame. It is therefore doubtless due to his courage that there was introduced and generally adopted the rigid frame construction now employed in our most powerful locomotives. The most notable of these Winans locomotives were the famous Camel engines, which were among the most powerful freight haulers of their day and were built in large numbers up to 1860.

In the late '40's and early '50's the public desire for more rapid passenger service led to the employment of large driving wheels for this class of transportation. Mr. Baldwin, first in the field with the Governor Paine, gave great impetus to the desire for better passenger locomotives. James Milholland, of the Philadelphia & Reading, whose work in the development of the locomotive will pass down into history, in 1852 constructed for that railway passenger engines having driving wheels 7 ft. in diameter. In detail of design,



Trevithick's Locomotive, 1803

the Milholland engines were undoubtedly among the finest of their time.

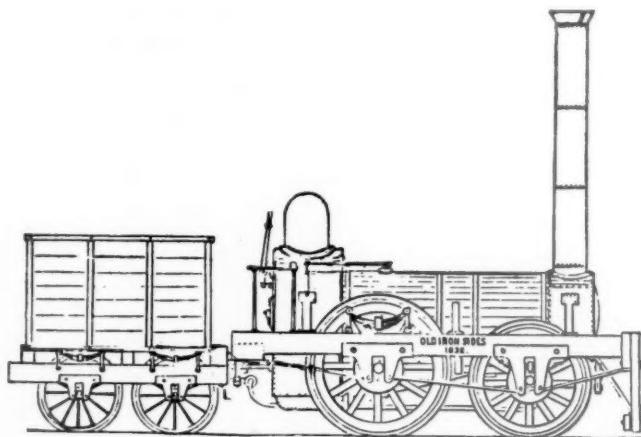
The Tiger, built by Mr. Baldwin in 1856, for the Pennsylvania, was one of the most successful passenger locomotives of that period. It used wood for fuel and its total weight was some 28 tons. In this same year an engine of this type was built for service in the south and is still working every day at Valdosta, Ga., being in its sixty-eighth year.

During the period of the Civil War almost anything that would run on wheels in the shape of a locomotive was acceptable. Many remodelings were made of antiquated structures, and locomotive designers became quite as numerous as the locomotives themselves. John P. Laird, at the Altoona shops of the Pennsylvania, was most active, and some of his

improvements, as for instance the Laird guide, exist today. Much was accomplished, and during the years intervening some of our railway systems began to consider the standardization of their power. This was most consistently and determinedly put in force by the Pennsylvania, and the changes of types on that system, while made regularly in order to keep abreast of the times, have always been given the most conservative consideration before adoption.

The Wootten Boiler

It was not until 1877 that interest was taken by the Philadelphia & Reading in locomotives to burn the refuse anthracite coal then produced in large quantities at the mines, and



Baldwin's "Old Ironsides," 1832

for which no market was available. The first locomotive of this character was designed by John E. Wootten, of the railway company, and was quite successful. Owing to the increased demand since made upon the steam generators of locomotives, the use of the Wootten boiler has developed what is known as the wide firebox boiler, now used with all kinds of fuel and in all classes of service. The Wootten design was a great departure, in my opinion did more for development and increased locomotive power than any other improvement of that period. It was quite a while before the merits of this construction were acknowledged, but it is now universally used.

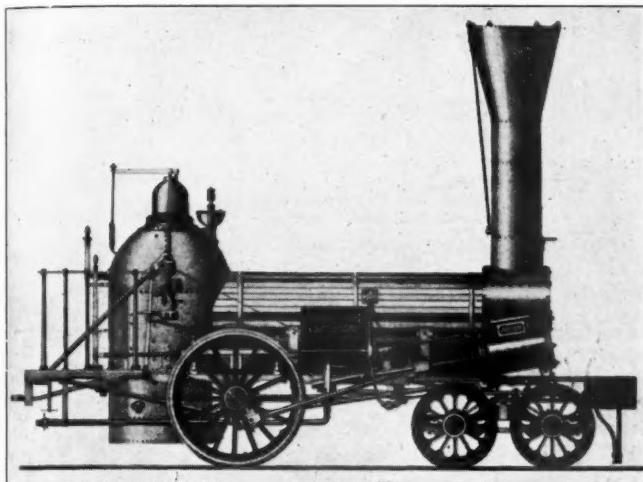
The desire for high speed with large trains where great tractive power was not necessary, led to the introduction, in 1894, of what is known as the Atlantic type locomotive, built to meet the requirements of the Atlantic Coast Line. This type was so successful that it became almost universally employed in passenger service, though under various names such as the Central Atlantic type, Chautauqua, etc. The underlying principle in each case was the same, namely, the use of the trailing wheel to carry the excess load involved by the employment of a boiler of exceptional steaming capacity and having a deep firebox suitable for burning bituminous coal.

The increased requirements of transportation, produced what is now commonly known as the Pacific (4-6-2) type locomotive, which is in general use throughout the country for heavy passenger service. For the heaviest class of service on steep grades, the Mountain (4-8-2) type is now being successfully employed.

The first so-called Consolidation type locomotive, built by The Baldwin Locomotive Works in 1866, was named in honor of the consolidation of the various small railway lines now comprising the Lehigh Valley System. It was a great success, and upon the same principles, Consolidation locomotives of enormous size and great efficiency have continued to be built.

Compounding and Superheating

About the year 1889, American locomotive designers became deeply interested in the compounding of locomotives. A considerable number of compounds of various types has been built and operated abroad. Almost any single expansion type then constructed was capable of having compound cylinders of some design applied, resulting in a more economical performance. Among the various types in use abroad were four-cylinder Mallet locomotives, originally designed for light service, and later built in large sizes for use in Russia. The first locomotive of this type built in the United States was purchased by the Baltimore & Ohio, and had two six-coupled units. It was exhibited at the St. Louis



An Early Norris Locomotive

Exposition in 1904, and later operated very successfully in mountain service. But inasmuch as this was a single locomotive, the type did not create sufficient interest among railway managers to come quickly into general use; and it was not until 1906, when James J. Hill, the Great Northern, purchased five of these engines on my recommendation, that wide-spread interest in the type was created. In order to get a proper estimate of their value, he isolated them and placed them on one section of the road, removing the locomotives of all other types. These locomotives were equipped with leading and trailing trucks, but in other respects were of the same type as the locomotive that had been previously constructed and put in use on the Baltimore & Ohio. The experiment was successful and Mallet locomotives for steep gradients or extreme conditions became popular.

Notwithstanding the fact that compound locomotives proved their economy and gave wonderful results, so far as economical consumption of fuel in freight service and high speed hauling power in passenger service were concerned, owing to the clearance limits prescribed, the constantly increasing size of locomotives made the use of compound cylinders more and more difficult. The use of superheated steam about this time, however, enabled engineers to produce locomotives almost, if not quite, as efficient as the compound locomotives had proven themselves to be, and to still further enlarge the size of units, increase their power and maintain a most satisfactory performance.

In this connection, mention should be made of two types of locomotives which have proved particularly successful in heavy freight service. These are the Mikado (2-8-2) and the Santa Fe (2-10-2). In both of these the trailing wheel principle as originated in the Atlantic type, has been applied for the purpose of providing increased boiler capacity. Furthermore, there is an added advantage in the trailer, as it provides a guide when running backward.

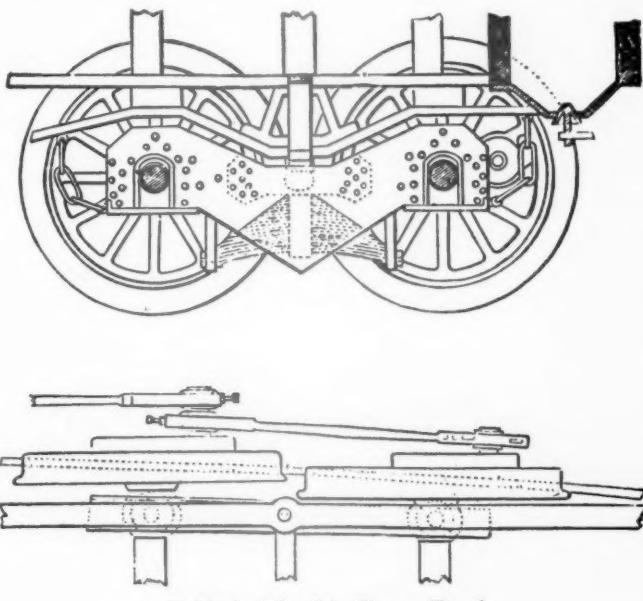
The standardization of locomotives by the Railway Ad-

ministration was a great benefit, as the consideration of the designs resulted in a much closer intercourse and exchange of thought among motive power men than could have been obtained in any other way; and while none of the classes developed will be continued in their entirety, many recent designs have as their bases administration locomotives.

There has at all times been an unceasing effort on the part of railway managers to use locomotives not only of greater capacity, but also of greater economy. Determined and loyal support has been given to every invention or contrivance intended to improve the efficiency of the locomotive and thus enable it to accomplish more work. To one who has given his whole life to this work and who has had opportunity to note the changes made from time to time in locomotive designs and appliances, the modern locomotive may be looked upon with some satisfaction; but also with a realization that the end has not been reached, and that the inventive genius of the future motive power experts will considerably change its form and increase its durability, efficiency and economy.

When the Giffard injector supplanted the pump for forcing water into the boiler, it proved a feed-water regulating device that enabled an engineer to operate his locomotive with absolute confidence. Now these same wonderful devices are being replaced by feed-water heaters and purifiers operated by exhaust steam. Can we not expect in the future an improvement that will purify the water before it enters the pump and thus prolong the life of flues and fireboxes?

When the size of locomotives had grown beyond the endurance power of the fireman to supply coal in proper quantity, the mechanical stoker came into play not only to relieve him of this back-breaking recreation, but also to supply the requisite amount of fuel and in a proper manner mechanically to the firebox. The superheater, the mechanical stoker, the feed-water heater and the power reverse gear are now absolute



Baldwin Flexible Beam Truck

requirements on the modern high duty locomotive. The firebrick arch in its perfected form, a perfection that has required some 50 years to accomplish, is indispensable.

The trailing wheels under our large locomotives, some of them carrying as much as 60,000 lb. of weight, have suggested the use of what is commonly known as the booster. This mechanical contrivance is simply a small steam engine attached to the locomotive trailing wheels, automatically controlled so that the weight carried by the trailing wheels can be utilized for starting heavy trains or overcoming of short grades which govern the tonnage that can be hauled over certain divisions of the road. By this means trailing wheel

locomotives in many classes of service can be made much more remunerative in their operation.

For many years the locomotive has been considered by the layman the most extravagant steam user and coal burning device in existence. This is entirely erroneous. The Pennsylvania at the present time is having built 475 locomotives with a tractive effort of 87,000 lb., equipped with mechanical stokers, fire brick arches, feed water heaters and super-heaters of the most advanced type. The cylinders are operated at half-stroke cut-off when developing full tractive effort, and the coal consumption per horsepower by actual test is equal to that of some of our best electrical power houses where turbines and condensers are employed, namely an indicated horsepower-hour for 1.83 lb. of coal. Every user of locomotives should examine carefully the construction of these engines. Notwithstanding the fact that they carry 250 lb. boiler pressure, there are many features employed worthy of general adoption.

A successful effort is now being made by railway managers to increase locomotive mileage by increasing the length of runs, and on a number of roads, notably in oil-burning districts, passenger trains are being run over five, six or seven hundred miles without change, except as to engine crews. One of the important factors responsible for the success of this method of operation is the use of hard grease as a lubricant, as this has eliminated much of the "oiling around."

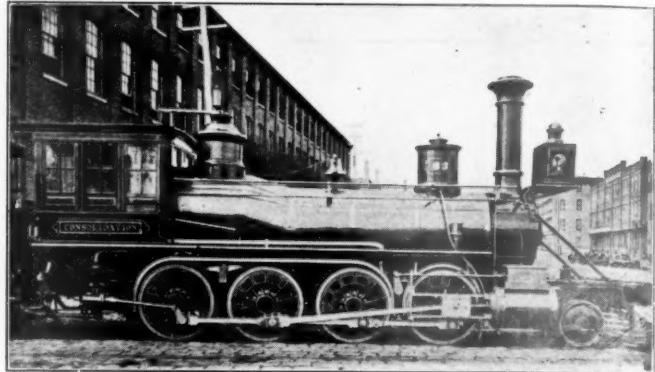
American Transportation Facilities Best in the World

Locomotive development during the past 90 years has been due entirely to the constantly increasing demand of business for better and cheaper transportation. The railway systems we now enjoy have been made possible by the enterprise of our pioneer railway builders of the past, who were courageously supported financially by the public as investors. The people of the United States quickly realized the prosperity that would follow the Iron Trail. Foreign investors were quick to absorb our railway securities and the twentieth century found us far better equipped with transportation facilities than any nation in the world.

This prosperity was naturally noticeable and perhaps in excess of that pertaining to other industries. The political

transportation lines were maintained equal to our business requirements. Terminal facilities had been perfected, the right of way made staunch and secure, by using new bridges, heavier rails and all other underlying requirements for the operation of maximum cars and locomotives.

The large expenditure of \$1,540,000,000 this year by the railway systems of this country to perfect and provide their facilities to enable the general business of the country to proceed without interruption, is well known by all. A further reflection shows that an annual increase of 7 per cent in our requirements, will during the next 10 years require at least a 7 per cent increase in railway construction and equipment in



The Original Consolidation Type Locomotive, Built in 1866 for the Lehigh Valley

order to keep abreast of the demands of an exacting public. In other words, an expenditure of approximately \$1,500,000,000 must be made annually during the next decade if we are to have dependable and proper service.

Over 4,000 new locomotives will be placed in service by our railways this year, capable of developing in the aggregate over 10,000,000 horsepower.

Public Opinion Must Be Put Straight

The time has now arrived when public opinion regarding the railway transportation systems of this country and the operating devices employed thereon must be put straight. There should be a campaign for the dissemination of information and facts concerning terminal facilities, extension of lines, and reduction of delays, also as to the improved mechanical appliances, that are vitally necessary to safety and service, not alone applicable to locomotives but also to other equipment, and the facilities that must be employed to maintain and keep in proper repair the modern high duty rolling stock, so that once more the general public will have confidence in the various railway organizations and will point to their accomplishments with a great degree of pride.

The general business of the country cannot progress faster than its transportation facilities will permit. The productiveness of our farms and workshops will go for naught if we do not have more efficient and more rapid facilities for the distribution of our products. The way to increase prosperity is to increase our general business, and to promote our transportation facilities and various public utilities by confidence and financial support, coupled with the creation of more efficient and economical devices in transportation equipment. We must all go out into the highways and byways of business, and speak to our business friends, encourage them to address their associates and workmen as to the necessity of abandoning the demagogue, political or otherwise, and to create among the general public a return of confidence in the vast army of transportation managers now responsible for the future of our country, and to become stockholders in all public utilities that contribute to our greatness, and especially the American railway.



Locomotive Built in 1866 and Still in Service

aspirants to fame seized upon the opportunity offered for establishing some very serious opinions among our business friends. The regulation of transportation, as to quality of service, methods of accounting and regulation of rates were soon paramount considerations and indulged in not only by our national legislators, but by state governments as well. The transportation horse was well curried but poorly fed, soon its bones were more in evidence than before so-called scientific management and regulation had been introduced.

What was intended for regulation in many instances proved to be strangulation, but by superhuman effort our great

Report on Brakes and Brake Equipment

Brake and Signal Equipment Rules Carefully Reviewed— A Number of Subjects on the Docket Continued

THE Mechanical Division's standard rules and instructions governing the testing, inspection, maintenance and operation of brakes and signal equipment have been carefully reviewed and the following recommendations are submitted by the committee:

Maintenance of Brake and Train Signal Equipment

Rules and regulations for testing, inspection, maintenance and operation of power brakes (freight and passenger):

(1) Replacing the air brake and train air signal instructions, shown on pages 65 to 74 of Section "E," Manual of Standard and Recommended Practice, with a suitable code of rules governing the operation of this equipment.

The committee has, therefore, prepared a proposed set of rules governing the operation of brake and train air signal equipment. These rules are shown in Exhibit 1 of the appendix of this report and are recommended for adoption as standard.

(2) A set of proposed rules governing the maintenance of brakes and air signal equipment on passenger cars, as shown in Exhibit 2 of the appendix of this report, similar to the standard rules governing the maintenance of freight brakes, and the same is recommended for adoption as standard.

The committee has carefully reviewed the rules and instructions in the Manual of Standard and Recommended Practice on the maintenance of freight brakes and while it does not find that these rules and instructions are subject to important fundamental revision there are a number of cases in which the rules can be clarified.

(3) It is, therefore, recommended that they be revised to conform to Exhibit 3 in the appendix of this report. In view of there being no important changes involved, no attempt has been made to enumerate the revision in detail.

(4) If the foregoing recommendations are adopted, the instructions for operating the Standard No. 1 and No. 2 triple valve test racks on pages 41 to 54 of the Manual should be added to Exhibit 3 and bound with Exhibits 1, 2 and 3 in one pamphlet for distribution.

The general arrangement and details of the air brake parts, shown on pages 3 to 9 and 11 to 13, and the details for high speed foundation brake gear, shown on pages 20 to 31 of the Manual, are not suitable insofar as dimensions are concerned for cars of present-day construction. In fact, owing to the many different types of cars in use and being constructed, it would be difficult to prepare complete detail drawings for the various parts of the brake rigging that would be suitable for the many types of cars involved.

(5) It is, therefore, recommended that the details shown on pages 3 to 9, 11 to 13, 20 to 31 and the six paragraphs appearing on page 19 of the Manual under "Designation of Rods and Levers" be stricken out of the list of standards and recommended practices and supplemented by specifications covering fundamental requirements for foundation brake gear and application of brake equipment to the car.

If this recommendation is adopted the committee will prepare specifications to cover.

We understand the design of standard freight cars, which is in the hands of the Car Construction committee, will include brake rigging for such cars.

The report is signed by G. H. Wood (Chairman), A. T. & S. F.; T. L. Burton, N. Y. C.; L. P. Streeter, I. C.; B. P. Flory, N. Y., O. & W.; Wm. Clegg, C. N. R.; W. J. Bohan, N. P.; R. B. Rasbridge, P. & R.; J. M. Henry, Penn. System.

Exhibit 1—Brake and Train Air Signal Equipment Operating Rules

1. Engine house foremen must have engine and tender air brake and air signal apparatus inspected and required repairs made before each trip.

2. When taking charge of an engine, the engineman must

know that the air brake and train air signal apparatus on the engine and tender is in good order, and at the end of the run must inspect the apparatus and report any defects.

3. Enginemen must know that hose on engine and tender are properly hung in dummy couplings.

4. Air compressors must be started slowly with drain cocks open. Air cylinders must be oiled only through the oil cup.

Car Inspectors

8. Foremen of inspectors and inspectors are jointly responsible for the condition of the air brake and train air signal equipment of cars leaving their station.

Standard Air Pressure and Piston Travel

10. Air pressure regulating devices on engines and cars must be adjusted for the following standard pressures:

	Lb. Pres. in	
	Brake Pipe	Main Reservoir
Engines, freight service, with single governor.....	70 to 90*	100 to 110
Engines, freight service, with duplex governor, low pressure	70 to 90*	100 to 110
Engines, freight service, with duplex governor, high pressure	70 to 90*	110 to 140
Engines, passenger service.....	90 to 110	110 to 140

*For heavy grade service.

	Lb. Pres.
Governor valve, water raising system.....	60
Reducing valve for independent or straight air brake.....	40 to 50
Reducing valve for train air signal.....	40 to 50
Reducing valve for water raising system.....	20
Reducing valve for high speed brake.....	60
Safety valve for straight air brake.....	45 to 55
Safety valve for LT control and ET distributing valves.....	40 to 68
Safety valve for LN and UC brakes.....	60

11. The piston travel with a full service brake application must be as follows:

	Inches
Engine truck brakes.....	5 to 6
Engine driver brakes.....	4 to 6
Engine tender brakes.....	6 to 9
Passenger equipment cars.....	6 to 8
Freight equipment cars.....	6 to 8

12. Before adjusting piston travel or working on brake rigging, cut-out cock must be closed, and reservoirs bled except where cut-out cock is in cylinder pipe.

Draining and Blowing Out Equipment

15. Air compressor drain cocks must be opened and left open while compressor is shut off.

16. Before engine leaves engine house the main reservoir must be drained and brake pipe and signal pipe blown out.

17. Air hose on engine must be blown out immediately before being coupled to train. Air hose on cars must be shaken (not blown out) to remove dirt from coupling.

18. Yard lines must be blown out at intervals and immediately before being coupled to cars or engines.

Time Allowed for Testing Brakes

20. Ample time must be allowed to properly inspect and test air brakes in all trains and place them in proper working order before leaving terminal.

Signals for Testing Brakes

22. Signals to engineman for testing brakes must be given by verbal request or by train air signal from forward car to apply, and by air signal from rear car to release. In the absence of air signal, hand or lamp signal must be given. Brakes must not be applied or released during a standing test until proper signal is given.

Brake Pipe Leakage

24. Freight trains must not leave originating points nor leave terminals where car inspectors are located and engines are changed when brake pipe leakage exceeds 8 pounds per minute (preferably it should not exceed 5 lb. per min.) following a

15-lb. service reduction from standard brake pipe pressure with brake valve in lap position.

Train Brake Test

26. When brakes are to be tested from yard plants, after blowing out yard line, train must be charged to the required pressure.

While brake system is being charged, a visual inspection of retaining valves and retaining valve pipes must be made, and position of angle cocks and hose ascertained. Close examination must be made for leaks and necessary repairs made to reduce leakage to a minimum.

When brake system is charged to standard pressure, a 15-lb. service reduction must be made, after which a second examination of the train must be made to determine:

- (a) Brake pipe leakage.
- (b) If brakes will apply in service application.
- (c) Piston travel.
- (d) That brake rigging does not bind or foul.

Release tests must be then made to determine if brakes release properly.

If, during these tests, the brake pipe leakage as indicated by the brake pipe gage exceeds 8 lb. per min., it should be reduced to 8 lb. (preferably 5 lb.) and if piston travel is less than 6 in. or more than 8 in., it should be adjusted to nominally 7 in.

After a road engine is coupled to a train, the brakes must be tested as prescribed in Rule 31.

27. Before a train leaves an originating point, where brakes have not been tested from yard plant, test must be made as follows:

After air gage on engine indicates within 5 lb. of standard brake pipe pressure, enginemen must, on request or signal, make a service brake pipe reduction of 15 lb., and determine by length and force of brake pipe discharge if there is open communication throughout the brake pipe. After the brake pipe discharge ceases and having noted brake pipe leakage, he must increase reduction to a total of 25 lb. Inspectors, or train crew, must then make certain that brakes have applied, that piston travel is not less than 6 nor more than 8 in., and that brake rigging does not bind or foul; inspectors or member of train crew must then give engineman proper signal for releasing brakes, and see that all release.

28. A defect discovered during a standing test that cannot be repaired promptly, must be reported by inspector or trainman to foreman inspector or conductor who will decide action to be taken.

When the test is completed the inspector or trainman will so inform the engineman and conductor, and advise them the number of cars having ineffective brakes in the train.

29. Before a train is started from a terminal the inspectors, or train crews, must know that all hand brakes are released and pressure retaining valves and angle cock handles are in proper position.

30. When cars are added to a train, the brakes on such cars must be tested as prescribed in Rule 27, and where practicable they should be charged before coupling them to the train.

31. When engines are changed, or an angle cock has been closed, except for cutting off car or cars from rear of train, an application and release test must be made from the engine. Inspector or trainmen will note that rear brakes of train apply and then signal for a release, noting that rear brakes release.

32. A running test of brakes must be made with passenger trains as soon as speed of train permits after engines or engine crews have been changed, after angle cocks have been closed and at a point which will permit train to be stopped by hand brakes, before reaching ends of double track, junctions, railroad crossings at grade, drawbridges, meeting and passing points and before going down heavy grades, and in case the brakes do not hold, at once signal for brakes. Such test should be made by applying the brakes with sufficient force to ascertain whether they are in working order. Steam or power should not be shut off when making the test unless conditions require it.

Movement of Cars with Brake Inoperative

35. Freight trains leaving an originating point must have all brakes in operation unless otherwise authorized. Car next to engine must have brakes operative. Three or more cars with brakes inoperative must not be placed together.

36. The movement of a car with brakes inoperative in passenger, mail, express or milk trains is restricted as follows:

From leaving originating point of train.

From being placed in train at intermediate terminals.

From being handled next to engine or at rear of train.

37. When brake pipe becomes defective on passenger, mail, express or milk cars enroute, signal pipe may be substituted for it by coupling signal hose at each end of car to brake pipe hose. Engineman must then be notified that one brake has been cut out.

Train Handling

39. Where engines are to be changed on passenger, mail, express or milk trains, the incoming engineman must leave train brakes applied.

40. When making service stops with passenger trains, not less than two applications should be made, except when graduated release is being used. The initial brake pipe reduction of either application should be not less than 8 nor more than 12 lb.

41. When making service stops with passenger trains of 7 or more cars, at low speed, brakes must not be released after final application until train has stopped, except when graduated release is used.

42. To stop a freight train but one application must be made, and initial brake pipe reduction should be from 5 to 7 lb. If steam or power is being used it should not be shut off, and, when conditions permit, engine brake not allowed to apply until stop is completed. After stop has been made, and before attempting to release brakes, total brake pipe reduction should be 20 lb.

43. A release must not be attempted, during brake application, until brake pipe discharge ceases.

44. When backing freight trains and it is desired to make service stop, initial brake pipe reduction should be 5 to 7 lb. and, when conditions permit, driver brake should be kept from applying and steam or power used lightly until train has stopped.

45. To release brakes on a freight train, brake valve handle must not be left in full release position longer than 15 seconds at any one time, except in heavy grade work.

46. Brakes must not be released on trains of 60 or more cars when moving at a speed of 15 or less miles per hour, except in grade work, when retaining valves are used. When releasing brakes on freight trains at higher speed or with shorter trains, the independent or straight air brake must be applied to prevent slack running out.

47. Conductor must notify engineman when braking of trains is not satisfactory.

48. When stopping freight trains of 25 or more cars for water or coal, air brakes must be applied by engineman and engine detached. If on a grade, hand brakes must be applied to hold train. While taking coal or water, engine brake must be held applied.

49. When using sand in making stops, its use should commence before brakes are applied and continued to the stop.

50. Should a train part, engineman must shut off steam or power and place brake valve handle in emergency position.

51. When engines are double headed, brakes must be operated from leading engine. Automatic brake valve on all but leading engine must be cut out, handles of brake valves must be in running position, and air compressors kept running.

52. The automatic and independent or straight air brakes on engines must be cut in. Independent or straight air brake alone should not be used for making stops with a train.

53. Engines or motors should not be reversed while brakes are applied.

Train Handling on Grades

58. In the absence of instructions, an understanding must be had between engineman and trainmen as to the number of retaining valves to be turned up before descending a grade. Retaining valves must be turned up from front to rear and turned down from rear to front of train.

59. Brake pipe pressure must not be permitted to fall below 55 pounds without being in position to safely release brakes and recharge auxiliary reservoirs. Before releasing brakes, speed of train must be reduced to give ample time to recharge auxiliary reservoirs to the maximum pressure.

60. Trainmen should watch carefully for hot wheels on descending grades, and if excessive heating is observed, turn down retaining valve. If this does not give desired results, stop the train, determine and remove cause or cut out the brake.

Emergency Application

62. When necessary to make an emergency application from the engine it must be done by quickly moving brake valve handle to emergency position and leaving it there until train stops. No attempt must be made to start train until brakes are released.

63. Conductors' valves must not be used except in case of emergency or as prescribed in Rules 64 and 67. When necessary to make an emergency application from train, conductor's valve must be opened quickly and kept open until train has stopped.

64. When whistle signal to apply brakes is given, train crew must quickly open conductor's valve and apply hand brakes. Conductor's valve must be kept open until train has stopped.

Conductor's Valve and Back-up Hose

67. If necessary to use conductor's valve for other than emergency application, it must be opened gradually and kept open until train has stopped. Engineman must lap brake valve and shut off steam or power. No attempt to release brakes must be made until train has stopped.

68. When back up hose is used, brake pipe must be fully charged and brake valve carried in running position. A brake test must be made through back up hose before train is moved. When engineman observes application has been made, he must give train crew hand signal, using white light by night.

Air Brake Hose

71. After a train is stopped by a burst hose, brake valve handle must be placed in running position so defective hose may be located.

72. Hose must be uncoupled by hand.

Train Signal Equipment

75. If a car discharge valve becomes defective in service, it must be cut out and conductor notified.

76. If necessary for a train to proceed with train air signal inoperative, train and engine crews must be notified.

Hand Brakes

80. In hump yard service, hand brakes must be known to be operative before cars are dropped over hump.

81. Hand brakes must be applied on cars left on side tracks and, when necessary, the wheels blocked.

Movement of Dead Engines in Trains

85. All engines equipped with side rods must have them applied, when handled dead in trains, suitable washers, or wooden blocks clamped together with bolts being used where necessary on main rod bearings to keep the side rods in place.

86. Engines and tenders must have air brakes cut in and operative on drivers, trailer, engine and tender trucks.

87. Engines and tenders equipped with ET or LT brake must have safety valve on distributing valve or control valve, adjusted to not less than 25 or more than 30 lb.

88. Engines and tenders equipped with automatic and straight air combined must have the safety valve in brake cylinder pipe adjusted to not less than 25 or more than 30 lb.

89. Engines equipped with ET or LT brake must have positive stops applied to handles of automatic and independent valves to secure these handles in running position.

90. Engines and tenders equipped with high speed brakes without the straight air must have high speed reducing valves set to reduce the brake cylinder pressure to not less than 25 or more than 30 lb., or must have a safety valve applied to brake cylinders or brake cylinder pipe set to not less than 25 or more than 30 lb.

91. Engines fitted with power brakes other than air must be equipped with an air train line and connections.

92. Engines equipped with ET or LT brake must have the cut-out cock of dead engine fixture open.

93. The cut-out cock in brake pipe under the automatic brake valve must be closed.

94. Air operated devices, with the exception of distributing or control valves, taking air from main reservoir must have the operating valve securely closed.

95. Not more than four dead engines may be handled in one train. There shall be not less than five cars between the engine hauling train and the first dead engine and between any two of the dead engines.

96. Delivering line will be held responsible for flat spots on driving tires, trailer tires and tender truck wheels.

97. Owners will be responsible for any special application of safety valves as required in Rules 87, 88 and 90, inclusive.

Reports

100. Defects in air brake or train signal equipment must be promptly reported on prescribed forms.

101. If defects develop or brakes are cut out on freight cars enroute, trainmen must apply defective air brake cards indicating defects on backs of cards.

Exhibit 2—Maintenance of Brakes and Signal Equipment on Passenger Cars

150. Brake cylinders, slack adjuster cylinders and high speed reducing valves shall be cleaned, lubricated and tested at least once in twelve months.

151. Triple valves, safety valves, and all portions of control valves, shall be removed from car for cleaning, lubricating and testing on a standard authorized test rack at least once in twelve months.

151. Centrifugal dirt collectors and strainers must be cleaned when the triple valve or control valve is cleaned.

Slack Adjuster, Adjustment

153. The automatic slack adjuster crosshead should be placed in extreme release position when all brake shoes are of maximum thickness. If the piston travel under this condition is less than 6 in. or more than 8 in. the travel should be adjusted to nominally 7 in. from a full service brake application by means of the brake rods and levers.

Shop Inspection and Repairs

156. When passenger cars are in shops for general repairs the entire brake equipment, including the hand brake, must be thoroughly overhauled, renewing or repairing, when necessary, missing or worn brake rods, levers, pins, hangers, supports and brake shoes.

157. The brake pipe and signal pipe should be thoroughly inspected and hammer tested, particularly at such places on the car as are not readily accessible to inspection and repairs when cars are in service, renewing, in each case, pipe that is found to be badly rusted or shows signs of weakness during the hammer test. The brake pipe and signal pipe shall be thoroughly blown out with air pressure after the hammer test is made and the dirt collector thoroughly cleaned. Pipe clamps and supports must be replaced where missing, and tightened where loose.

158. The brake cylinder shall be cleaned as prescribed in Rules 217 and 227 for freight cars.

159. The brake cylinder shall be tested for leakage after cleaning, with an air gage attached to the triple valve or control valve exhaust, or to the vent port in the brake cylinder cut-out cock. The leakage should not exceed 5 lb. per minute, from an initial pressure of 50 lb. and piston travel adjusted to nominally 7 in.

160. The retaining valve shall be cleaned and tested. If accessible it may be cleaned without removal from the car.

161. Triple valves, high speed reducing valves and compensating valves should be cleaned and lubricated as prescribed in Rules No. 240 to 257 for freight cars. High speed reducing valves and compensating valves should be adjusted to close at 60 lb. cylinder pressure.

162. In cleaning the control valve of the universal type, clean all internal parts with gasoline, or a suitable oil, except rubber seats and gaskets. After cleaning, all parts must be blown off thoroughly with air pressure and wiped dry with a cloth, after which, seats, faces of all slide valves, slide valve graduating valves and upper portions of bushings where the slide valve spring bears, must be lubricated with dry graphite in the same manner as outlined for triple valves.

163. The equalizing piston and its cylinders, both ends of the release piston and the emergency piston and its cylinder, slide and graduating valve and bushings should be lubricated the same as the triple valve piston, cylinder, slide and graduating valve and bushings.

164. Before replacing the charging valve and graduated release piston in their bushings, apply one drop of anti-friction oil to each of the bushings, distributing the oil over the surface with the finger, making sure that the valve and piston move freely in their bushings.

165. Check valves in the equalizing or emergency portions should not be lubricated, but wiped clean. Before replacing the intercepting valve, protection valve, high pressure and cut off valve, apply one drop of anti-friction oil to each of their bushings, distributing the oil with the finger.

166. The intercepting valve bushing is a slip bushing. The outer surface and the bore in the valve body should be wiped clean and a light coating of dry graphite applied.

167. The quick action piston does not require lubrication; but the piston and bushing should be wiped clean and dry.

168. The safety and cut off valves should be thoroughly cleaned and the seat of the latter examined, and renewed if found defective. Adjust the safety valve to open and close between 58 and 62 lb. brake cylinder pressure.

169. No hard metals should be used to remove gum or dirt or to loosen the piston packing rings in their grooves. Unless necessary to apply new packing rings they must not be removed from groove or distorted in any manner. This applies to all packing rings in triple valves and control valves.

170. All pipe joints, including those in the signal system, hose, release valve, angle and cut-out cocks should be tested under a pressure of not less than 90 lb., using soapsuds for this test when weather conditions permit, reducing all leakage to a minimum.

171. With the brake system charged to standard pressure, make a 20 lb. service reduction, after which make an examination of the brake to determine:

- (a) Brake pipe leakage.
- (b) If brakes will apply in service application.
- (c) Piston travel.
- (d) Brake cylinder leakage.
- (e) That brake rigging does not bind or foul.

Release test must then be made to determine if brakes release properly.

172. If during this test, the brake pipe leakage as indicated by the brake pipe gage, exceeds 5 lb. per minute, it must be reduced to 5 lb. and if piston travel is less than 6 in. or more than 8 in., it must be adjusted to nominally 7 in.

173. The retaining valve and its pipe must be tested and made to hold the brake applied at least 3 minutes following a release from a full service application.

174. Conductor's valve, car discharge valve, platform, or "back up valves" and whistles should be tested under pressure and known to be in proper working order.

175. All defects found must be repaired and all stencil marks scraped off and painted over, and the brake restenciled in accordance with the railroad company's drawing or instructions.

Terminal Yard Inspection and Repairs

179. Passenger cars in terminal yards should have the air brake and train air signal equipment tested as follows, at periods to be specified by road involved:

180. Where facilities are provided, charge the cars from a yard air plant, to not less than 90 lb. for the brake system and not less than 40 lb. for the signal system.

181. While the train is being charged, make an examination for leaks from the brake and signal system and reduce the leakage to a minimum. Make a visual inspection of stencil date, brake rigging, hose, position of angle and stop cocks, retaining valves, retaining valve piping, hand brakes, attachment of reservoirs and cylinders to their supports and the supports to the car. Any hose leaking around fitting or otherwise defective, and cocks found leaking at top of key should be replaced. Brake shoes should be renewed when necessary.

182. When the brake system is charged to standard pressure, make a 20 lb. service reduction, after which make a second examination of train to determine the five conditions from (a) to (e) listed in Rule 171.

Release test must then be made to determine if brakes release properly.

183. If, during this test, the brake pipe leakage as indicated by the brake pipe gage exceeds 5 lb. per minute, it should be reduced to 5 lb. or less. If piston travel is less than 6 in., or more than 8 in., it should be adjusted to nominally 7 in., with slack adjuster cross heads in proper position. The air signal must operate properly from front and rear cars. All defects found shall be repaired.

Exhibit 3—Maintenance of Freight Brakes, Rules and Instructions

[In general, these rules have been clarified but without important changes and with few additions. In the table showing the types of retaining valves a 10- to 20-lb. double pressure spring type valve has been added.—Editor.]

Discussion

There was no discussion of this report.

(A motion to accept the report and submit it to letter ballot was made, seconded and carried.)



Railroad Cars, Their Origin and Development

What the Growth in Capacity Has Meant to Civilization, and the Factors Making it Possible

By E. F. Carry
President, The Pullman Company

WITHOUT TRANSPORTATION FACILITIES the farmer today would be marooned on his acres; he would be a localized industry. He would be dependent entirely upon what his soil produced; be without a market for his products; clothed in homespun and in skins. With the farmer isolated there could be no great communities, no manufacturing centers, no factories. If some great calamity should destroy railroad connection with any large city, that city in 48 hours would feel the pangs of hunger and inside of a week its inhabitants would either have to seek food elsewhere or die in the streets. Without transportation diet would be restricted. Bread would be a drug in the wheat states and practically unobtainable where wheat does not grow. Meat eaters would have to move to where cattle range; babies in great cities would die from lack of milk. The great fruit orchards and vegetable farms of the South and West which through the aid of the refrigerator car are enabled to supply the tables of the North and East with their products, would go out of business. Ore would stay in the earth; coal would remain unmined; cotton plantations of the South would revert to weed patches and the sheep of the West would remain unshorn. Life would hardly be worth living if we had to rely on the means of locomotion and carriage provided by nature.

Land transportation had its origin in the pre-historic age and in man's primordial state woman was the burden carrier, as she is today among the savage races of the world. Just when primitive man transferred the burden from the shoulders of a woman to the back of an animal is a matter of conjecture but the transfer was final and the first step in solving the problem of land carriage was directly traceable to that occurrence.

Animal-drawn vehicles served the purpose of land transportation until the seventeenth century when the necessity for increasing capacity led to the adoption of wooden rails at the collieries of England for the conveyance of coal to the river or the sea. This marked the inception of tramways or colliery roads, and from the seed thus planted came the railroad. With the introduction of the steam locomotive, passenger cars came generally into use, and it is difficult from this period forward to trace separately the progressive improvements in the development of freight and passenger cars, as most of the mechanical features were developed concurrently on both classes of equipment.

Freight Car Development

On the Mauch Chunk, one of the earliest coal roads, each car had a dead weight of 1,600 lb. and a capacity of 3,200 lb.,

the ratio of dead-weight to carrying capacity thus being as 1 to 2. On the Little Schuylkill, another early coal road in Pennsylvania, the cars were built to carry three tons of coal and were equipped with wheels three feet in diameter, two of which were loose on the axles in order to lessen friction on the curves.

With a rapidly growing population and a gradual widening in areas of distribution, however, the constantly increasing traffic demands upon the early railroads necessitated an increase in the number of the small capacity cars, but the addition of these extra units to the train so increased length as to render it unwieldy and difficult to handle. The necessity for an increase in the unit capacity of freight cars became apparent and the introduction of four-wheeled trucks not only rendered this possible but, also, marked the first step in the evolution of distinctively American types of freight cars.

Prior to 1870, however, freight cars were still of limited capacity as an average load of nine tons per eight-wheeled car and four tons per four-wheeled car was considered heavy loading. The eight-wheeled cars in use on one road were 28 ft. to 33 ft. in length, had an average dead-weight of 16,000 lb. and a loading capacity of 18,000 lb., the ratio of dead-weight to carrying capacity thus being 1 to 1 $\frac{1}{8}$. Up to 1876 the average capacity of freight cars remained at 20,000 lb. although it was customary to load in excess of that figure. In 1877 some cars were built to carry 30,000 lb. and beginning in 1879 the standard cars built for the principal lines were constructed to carry 40,000 lb.

The comparative weight of a standard Pennsylvania Railroad box car, with its load, in 1870 and 1881 was as follows:

Year	Weight of car, lb.	Weight of load, lb.	Total	Load to total weight per cent	Ratio of dead weight to carrying capacity
1870.....	20,500	20,000	40,500	49.38	1 to 1
1881.....	22,000	40,000	62,000	64.52	1 to 1.8

This shows considerable progress was being made in the matter of increasing the carrying capacity of freight cars with little, if any, increase in the dead-weight. Notwithstanding the gain of 30 per cent in the ratio of paying weight to gross weight the ratio of dead-weight to paying load was 1 to 1.8, indicating the difficulty which the roads were experiencing at that period in obtaining the ratio of 1 to 3 which Jonathan Knight, civil engineer of the B. & O., as early as 1832 submitted as the most economical.

As contrasted with the situation 40 years ago, the following table, showing for certain types of modern freight cars the ratio of dead-weight to carrying capacity, will indicate



Edward F. Carry

the remarkable progress made by the railroads and the car builders in designing cars that give an economical ratio between the weight and load which is to be carried:

	Weight of car lb.	Load, lb.	Total, lb.	Per cent of load, total weight	Ratio of dead weight to carrying capacity
1919 U. S. R. A. single sh. box.	46,900	110,000	156,900	70	1 to 2.35
1919 U. S. R. A. double hopper.	41,000	120,000	161,000	74	1 to 2.93
1919 U. S. R. A. gondola.....	43,100	110,000	153,100	72	1 to 2.55
1921 Virginian coal car.....	78,900	240,000	318,900	75	1 to 3

This indicates that the predicted ratio of 1 to 3 has been attained for certain types of coal cars and in the case of an experimental ore car a ratio of 1 to 4 was reached. The economies to the railroads and to the public resulting from these developments are obvious.

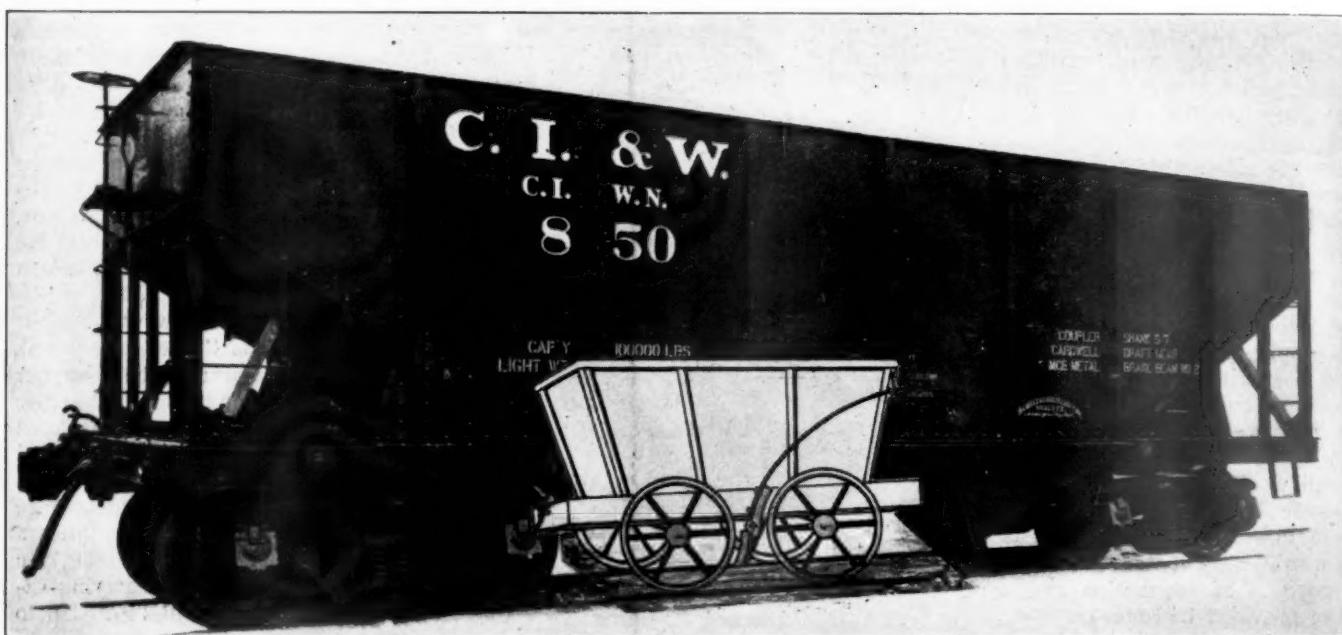
Three Important Events of 1867-68

The year 1867 was a vital one in the annals of American railway car building. The predecessors of you gentlemen assembled here today met and formed The Master Car Builders' Association, and on Washington's Birthday of that same year there appeared on the transportation stage a young man,

indebted for the progress in railroad equipment. Some idea of what the M. C. B. has accomplished in the way of standardization of car parts may be observed from the following list which summarizes the achievement up to the present time:

Journal boxes—58 kinds reduced to 5 sizes, one interchangeable type.
Axles—56 kinds reduced to 5 sizes, one interchangeable type.
Couplers—26 kinds reduced to 1.
Brake Shoes—20 kinds reduced to 1.
Brake heads—27 kinds reduced to 1 interchangeable standard.
Wheels at present, three types—4 sizes.
Grab beams at present—all interchangeable.
Grab irons fixed by law.
Draft gear—standards being prepared by Mechanical Division, A. R. A.

The Westinghouse air brake opened the way for the safe handling of trains of increased length and cars of higher capacity. Its value to operation was demonstrated in 1887 by a test on 50 freight cars, a train of 1,900 ft. and a weight of 1,700,000 lb., which was brought to a stop from a speed of 20 miles an hour in a distance of 171 ft. To stop the same train at the same speed by the use of hand brakes by



Coal Car in 1830 and a Coal Car of Today

who was destined to become one of the world's greatest master car builders, a man whose vision and genius enabled him to surmount what had seemed insuperable obstacles; a man who foresaw the possibilities of giving to the American public comfort and luxury in travel—George Mortimer Pullman. He was a pioneer, the creator of a new business.

In the same period there came another advancement of great significance, the invention of the Westinghouse air-brake, and its successful application in the winter of 1868-1869 to eight cars and an engine on the Steubenville accommodation train on the Pittsburgh, Cincinnati & St. Louis.

The organization of the Master Car Builders' Association marks what was virtually the first step in the standardization of interchange parts of American cars. The work accomplished by the association in this respect has been and will continue to be of incalculable value to railroad operation. In its Standards and Recommended Practices the association has created a monument appropriate to the purposes of its organization, viz.: "The formation and dissemination of correct views regarding car construction." To the railroad officers of which the association was composed we are

five men, all ready for simultaneous action, required a distance of 1,563 ft.

In 1857 an eastern railroad had 30 box cars fitted with double sides, roofs, floors and the interstices packed with sawdust. This in its crude form was probably the first refrigerator car. In 1871 there was introduced a refrigerator car equipped with ice bins, or compartments, at the ends of the car and about 1881 the first stock car with watering troughs and feed bins was constructed.

Automatic Couplers and Air Brakes

Made Steel Underframes Necessary

The introduction of the automatic coupler, extending over a period from 1883 to 1888, tested by the Pennsylvania in 1883 and 100 sets tested by the C. B. & Q. in 1884, marked another great forward step in the safe and prompt handling of freight equipment, obviating the need of a man between cars in coupling.

With the advent of the air brake and the automatic coupler, permitting high speed and quick handling of heavy equipment, the inadequacy of the wood frame car became apparent. Wooden draft timbers bolted to the bottom of wooden center

sills pulling out, wooden center sill breaking at bolsters and the difficulty in obtaining an adequate supply of timbers for the gradually increasing sizes of cars, made a change to stronger and more readily obtainable materials imperative. Thus, born of necessity, came draft sill reinforcements of steel, steel underframes for wood cars, steel frame cars and steel cars.

Development of Steel Freight Cars

The use of steel in car construction probably was first introduced in 1874 in the form of channel iron for sills and bolsters in a car operated in stock service on an eastern line. In the late seventies or early eighties a peculiarly shaped iron body hopper car, known from its shape as a three-pit hopper, was introduced. This was of 13 tons capacity, weighing 12,800 lb. Southern Iron Car Line in about 1882 introduced what was known as the pipe car, the center and side sills of which were of truss type, pipes acting as top and bottom members held apart by separating clamps. End sills were of malleable iron and later trussed iron bars, bolsters

number and carrying capacity of freight cars as well as the extent to which maximum utilization of the increased capacity has been secured. The following tabulation shows the number, capacity and average loading of freight cars during 1921 as contrasted with 1902, the earliest year for which reliable data are available regarding capacity of all freight cars in service. It presents a striking picture of the advance made during that 19-year period.

GROWTH IN CAPACITY AND UTILIZATION OF FREIGHT CARS

	Number of cars	Aggregate capacity, tons	Avg. capacity per car, tons	Average net loaded per car
1902.....	1,546,101	43,445,438	28.1	16.92
1921.....	2,378,682	101,093,985	42.5	29.30
Per cent increase, 1921	53.9	132.7	51.2	73.4

Notwithstanding the remarkable expansion reflected above in the number of freight cars it will be noted that their aggregate carrying capacity has increased at a rate nearly two and one-half times faster than the increase in units.

In the United States, the old Concord stage coach was adapted to railroad usage by the application of flanged



The Progress of 92 Years—Early English Stock Car Compared with Modern American Type

were of angle iron. This type of car proved unsatisfactory in service.

It was not until 1894 that the modern steel car became a recognized unit of American railway service. In that year the Carnegie Steel Company had six flat cars built, and in 1896 the Keystone Bridge Company built two 100,000-lb. capacity steel hopper cars which were exhibited at a convention at Saratoga and afterward placed in service on the Pittsburgh, Bessemer & Lake Erie. This railroad in 1897 placed the first large contract for building steel cars in this country when 1,000 cars were built, 600 of pressed steel and 400 of rolled structural shapes.

From that period forward, progress in the construction of steel freight cars has been rapid, as indicated by the following comparison of cars in service on Class I roads as of December 31, 1921:

Total number of cars in service.....	2,378,682
Steel freight cars in service.....	640,891
Proportion of steel cars, per cent.....	27
Steel underframe cars in service.....	903,240
Aggregate number of steel and steel underframe cars.....	1,544,130
Proportion of steel and steel underframe cars to total, per cent..	65

One of the most remarkable features in connection with freight car development has been the rapid increase in the

wheels. Other accounts depict the first passenger cars as nothing more than clumsy, covered box wagons fitted with planks for seats, while the first passenger car on the B. & O. was like a small clap-boarded wagon on wheels, similar in appearance to a North Carolina mountain hut. The first cars were propelled by horse power, with a capacity of from 12 to 24 passengers.

Development of Passenger Cars

The introduction of the bogie truck by Ross Winans on a B. & O. passenger car about 1831 ushered in the first eight-wheeled car, and marked the beginning of the radical difference between the English and American cars. The ability of this eight-wheeled car to round curves which abounded on most railroads led to its general adoption by about 1835.

The typical eight-wheeled passenger coach built between 1840 and 1850 was devoid of springs aside from the ordinary rubbers in the pedestals; the only ventilation was by means of a 10-in. flue in the center; the windows did not raise but the panels between them could be lifted instead; there were no lighting arrangements except a candle placed at each end of the car; heat was supplied by one stove; there

were no closets, lavatories, or water coolers; the wheels were outside of the bearings on the original trucks; the seat frames were of iron with walnut arms and upholstering of plain leather; and the body of the car was 36 ft. in length, 8 ft. 4 in. in width and 6 ft. 4 in. in height. While the arrangements of the car indicated marked progress in passenger car construction it was conspicuously lacking in a number of modern improvements.

From 1860 to 1870 passenger cars in general use had seating capacity for about 60 passengers and a body about 50 ft. long, 10 ft. wide and 7 ft. high; seats were cushioned and heat was furnished by stoves and light by oil lamps. These cars were equipped with rubber and elliptic springs, the metal for axle bearings was in process of experimentation, hand brakes were still in use and attempts were being made to devise a reclining seat.

During the seventh decade sleeping cars on through lines first became effective and dining and parlor cars made their initial appearance. The influence of the Pullman car has seemingly been a potent factor in the development of passenger carrying equipment. As the Pullman Company was the originator of de luxe sleeping car service, so also it was the initiator of complete hotel service as applied to trains. In 1867 it introduced the hotel car "President," a sleeping car with a kitchen at one end, and this was the forerunner of the dining car (a later development by the company) which supplanted the hotel car.

The original wood frame passenger cars were improved by

cars are being rapidly displaced by all-steel and steel-under-frame cars. The extent to which these types are superseding the wooden car is disclosed by contrasting the classified passenger and Pullman car ownership as of January 1, 1922, with the ownership as of January 1, 1911, as follows:

	1911	1922	Increase Number	Per cent
Wood cars	53,274	33,433	*19,841	*37
Steel-underframe cars..	1,636	9,505	7,869	481
Steel cars	3,589	20,569	16,980	473
Totals.....	60,499	63,507	3,008	5

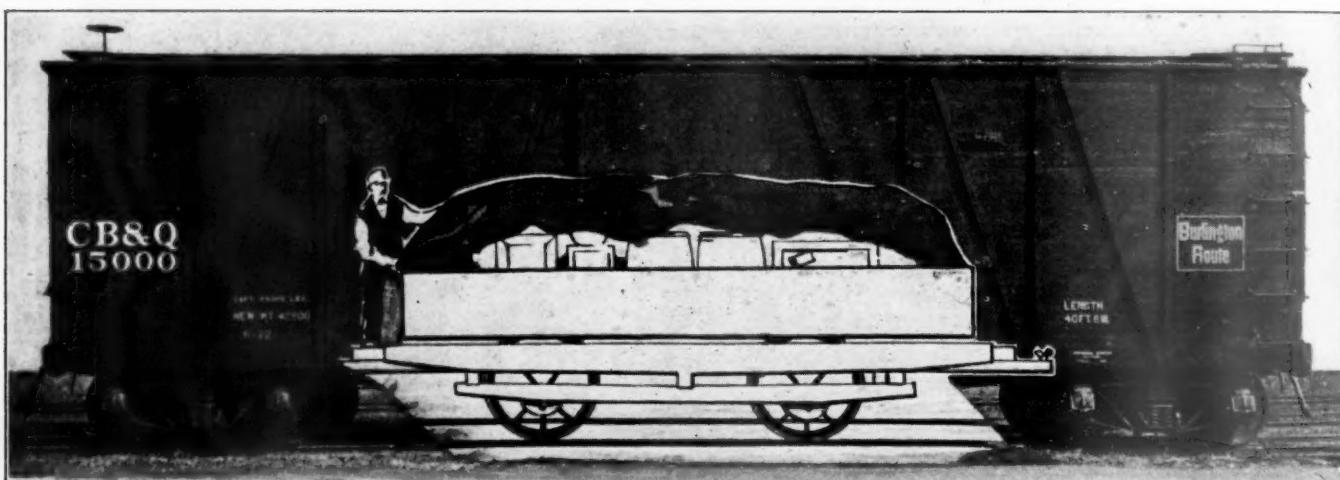
*Decrease.

The criticism has been made that the passenger coach of today differs but little from the coach of 25 years ago, but a comparison of a typical coach of 1898 period with one built in 1922 will readily disclose the radical differences between both cars.

PASSENGER COACHES—TODAY AND 25 YEARS AGO

	1898 Model	1922 Model
Length	48 ft. 6 in.	70 ft.
Weight	53,000 lbs.	140,400 lb.
Capacity	56 passengers	84 passengers
Construction	Wood	Steel
Wheels per truck.....	4	6
Platform	Open	Vestibuled
Lighting	Oil lamps	Electricity
Heating	Coal stove	Steam

Modern American passenger equipment has been subjected to criticism as being too heavy. Safety is the first consideration in the minds of every master car builder and high speed has made it necessary to so construct cars that their



Pioneer English Goods Wagon Compared with Present American Box Car

increases in size and carrying capacity so far as consistent with safety in connection with wood construction. Next came composite steel construction and finally the all-steel passenger car and the transition from wood to steel construction assumed such proportion that there was virtually created a new industry in connection with car building, viz., the production of steel cabinet work for the interior finish. The first all-steel passenger car turned out by the Pullman Company was built in 1908, although the Pennsylvania had acquired some steel cars at an earlier date.

With the arrival of the steel age it is of interest to note the evolution in interior decorations. From the wood interior of the early days which were entirely devoid of any attempt at embellishment there came the era of highly ornate style with inlays, heavy carvings, and other embellishment which was followed by gradual reversion to plainer styles with less ornamentation and, finally, there was adopted the plain, sanitary and modern steel finish of today with a minimum of decorative features.

Contrasted with the original crude passenger car, there are now many and varied types of cars. Light wooden passenger

various parts must be heavy enough to provide an ample margin of safety and strength, not only to resist the sudden shocks and distortion stresses on the structure which use imposes, but also to give ample provision against deterioration and reduce the cost of maintenance to a minimum. Light cars have proved unequal to the requirements of American passenger travel. The weight of modern passenger equipment is the result of service demands—the safety and comfort of passengers—and these requirements are its adequate defense.

When it is considered that the modern passenger car is equipped with electric lights and steam heating systems, toilet and wash-room facilities supplied with running hot and cold waters, coolers for drinking water, drinking cup vendors, electric fans, upholstered seats with headrest and automatic foot rest, continuous parcel racks on each side of car, window shades, windows that can be raised and lowered, exhaust ventilators in deck sash in body of car and in men's and women's saloons, an interior finish of mahogany color, etc., it will be seen that the all-steel passenger coach in its present stage of development embodies the maxima of safety, com-

fort and convenience insofar as engineering ability, mechanical ingenuity and scientific research can contrive.

Development of Car Equipment in Relation to Traffic

To illustrate the extent to which railroad traffic has increased the following is presented:

	1890	1920	Increase per cent
Population	62,947,714	105,710,620	68
Total revenue ton-miles (millions).....	76,207	413,674	443
Ton mile revenue freight per inhabitant per annum	1,200	4,000	233
Ratio increase in ton-miles per inhabitant to increase in population.....	1	3½	...

These figures afford an index of the extent of our industrial expansion and direct attention to the service which the railroads have rendered as builders of business by effecting a solution for the multitude of problems which such expansion has involved. To the skill of the master car builder much of the credit is due.

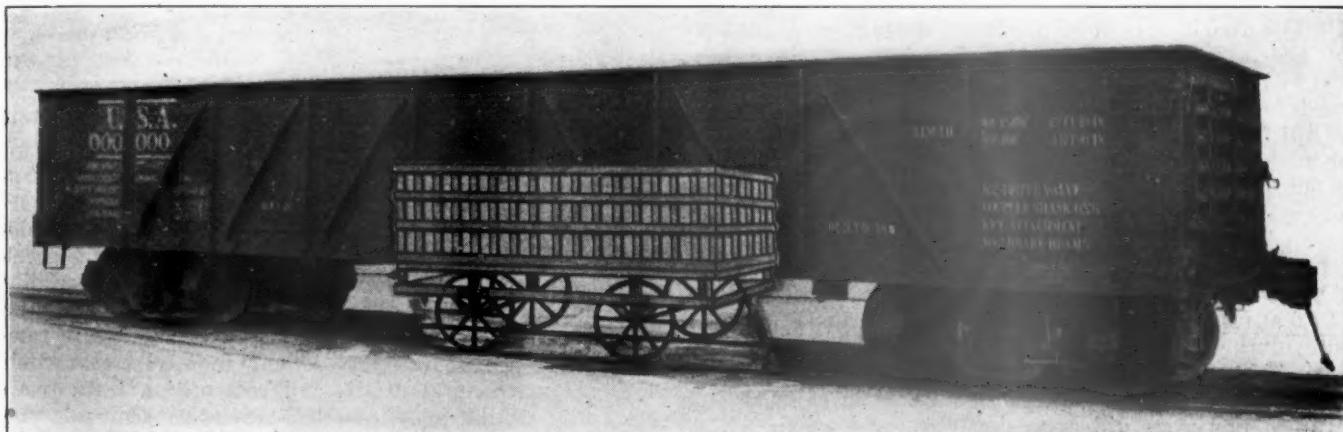
In attempting to solve this problem the railroads found that a mere increase in the number of locomotives and cars of the same types and capacities as were in service 20 or 30 years ago was not practicable. The adoption of such a method would result in congestion of physical plants with all the attendant evils such as traffic embargoes, exorbitant costs, etc., which would prove burdensome alike to railroads,

the occupancy of line and terminal trackage, thereby reducing tractive resistance by minimizing wheelage and dead-weight, at the same time decreasing maintenance costs and dead-time by curtailing the number of units.

The extent of the development from 1902 to 1921 (the last year for which complete statistics are available) is shown in the following figures:

	1902	1921	Increase, per cent
Total number of freight cars owned	1,546,101	2,378,682	54
Aggregate carrying capacity.....	43,445,438	101,093,985	133
Unit carrying capacity, tons.....	28.1	42.5	51
Ton-mile traffic handled (millions).....	157,289	309,443	97
Miles of yard and side tracks.....	58,221	100,705	73

Had the traffic demands for greater carrying capacity been accommodated during the intervening years by the seemingly simple process of adding locomotives and freight cars without any attempt at changing their design or capacity, it would have been necessary to add 2,051,550 freight cars, making the total number of freight cars required under such a plan 51 per cent greater than the actual number of freight cars in service during 1921. The addition of this number of freight cars, ratably determined, would have required 77,250 miles of additional yard and side trackage, an increase of approximately 133 per cent over the trackage of 1902, or 35 per cent more yard and side trackage than was in existence in 1921. Furthermore, 22,823 additional freight



Early English Gondola Compared with Its American Big Brother

shippers and consumers. A given mileage of main track complemented by a given mileage of yard and side tracks can accommodate only a certain number of cars and locomotives and this situation therefore is the limiting factor as regards the number of trains that can be moved daily.

Furthermore, if the simple process of multiplying rolling stock were confronted by no obstacle other than physical limitations, the twin factors of increased capital investment and rising operating costs would act as a check upon such a method. The construction of additional track mileage, entailing enormous capital expenditures and constantly increasing expenses for maintenance, replacements, taxes, and other incidental costs, can be justifiably and economically undertaken only when maximum utilization of the existing facilities of that character has been obtained.

The necessary alternative of the railroads, therefore, has been to secure the most intensive and efficient utilization of the existing plant and to accomplish this the first step was an increase in the efficiency of the motive power, thereby enabling it to haul greater loads at the same or at a lesser expense. An increase in motive power can accomplish only a small fraction of the desired results, however, unless it be accompanied with a corresponding increase in the capacity of freight cars and an improvement in their structural design, the cumulative effect of which is a greatly increased train load. This is the most effective method of condensing

locomotives—or 97 per cent more than the number in service in 1902—would have been required to handle the additional gross tonnage. It may be well to leave to your conjecture the tremendous expansion which would have been required in all other complementary facilities to accommodate the demand for increased capacity had the railroads attempted to meet the problem by the impracticable method of simply increasing the number of equipment units.

The addition of 2,051,550 freight cars alone during the 19 years referred to would have been in excess by 1,218,969 cars of the number of freight cars actually added during that period; at an average cost of \$1,500 per car these 1,218,969 extra cars would have required an additional investment aggregating \$1,828,454,000, the capital charges on which, alone, at 6 per cent would have amounted to \$109,707,240.

Furthermore, if during the period from 1902 to 1921 the railroads had simply added 2,051,550 freight cars with an average unit capacity of 28.1 tons, corresponding to that of the equipment in service in 1902, they would have been forced to handle 6,449,000,000 additional loaded car-miles in 1921 to accommodate the traffic actually transported in that year, the direct transportation cost of which alone, on basis of 1921 costs, would have added over \$300,000,000 to their expenses.

The effect upon transportation rates—which vitally affect the shipper and consumer—resulting from these inordinate

increases in capital and operating expenses cannot be appraised, but it is obvious that any attempt to maintain a freight rate level sufficiently high to protect these burdensome costs would have proved inhibitive of traffic.

The output of the transportation industry is measured in traffic units of tons and passengers carried one mile, and the efficiency with which the transportation machine has functioned by reason of the increased unit capacity and weight of equipment, more intensive utilization of facilities, reduction of curvatures and gradients, etc., is strikingly reflected by a comparison of results during the period from 1890 to 1920.

	1890	1920	Increase per cent
Population	62,947,714	105,710,620	68
Traffic units handled (millions).....	112,750	587,824	421
Tons handled per train.....	177.42	652.40	268
Freight traffic density.....	493,638	1,748,451	254
Passenger traffic density.....	75,751	199,708	164
Traffic unit handled per capita population	1,791	5,560	210
Index number of wholesale prices of commodities	82	189	130
Average freight rate (mills).....	9.41	10.52	12

The normal development of railroad equipment was limited by war restrictions during the four-year period, 1915-1918, and by financial restrictions during the ensuing years, 1919, 1920 and 1921, but notwithstanding the fact that only 100,000 freight cars were purchased during the 26 months of Federal control—approximately 46,000 cars per year—the average number of new freight cars added by the railroads over a period of 10 years, 1913-1922, has amounted to 101,009 annually. To overcome any existing freight car shortage and to accommodate present and future traffic demands of commerce the railroads, in recognition of the necessity confronting them for the maximum improvement and expansion of their transportation facilities, expended \$200,000,000 for freight cars in 1922 and have authorized additional expenditures for freight cars of, approximately, \$515,000,000 for 1923. When we add to this the actual expenditures during 1922 and the authorized expenditures for the year 1923 for locomotives, additional trackage and other facilities, the sum total of money invested in expansion of railroad properties will approximate one and a half billion dollars.

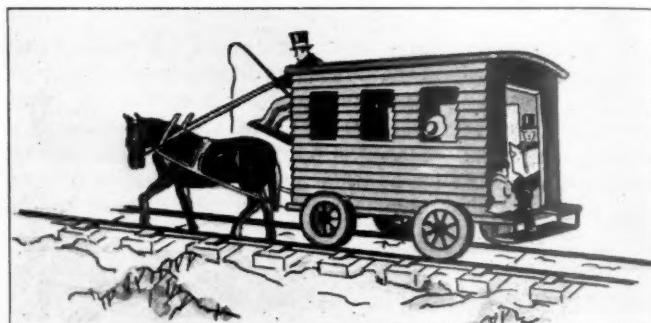
Conclusion

Ninety years ago Mons. A. Notre of Paris, a farsighted Frenchman, wrote:

"The public and private advantages, already derived from this (railroad) system, have reduced it to a certainty that

this mode of construction can be adopted on long roads, with a view to both swiftness and economy. Agriculture, commerce and manufactures will acquire a new impetus, from the communication with the most distant markets, being rendered more rapid and cheaper; the poor man will no longer be obliged to deny himself that which was formerly beyond his means; the rich man will be conveyed with a velocity which formerly all his wealth could not have procured for him, and in a political and military point of view, the mind is lost in its imaginings; nations may collect their armies on their frontiers as if by enchantment."

His vision was prophetic. He painted a large picture, a picture which doubtless in his day was viewed with skepticism. Today there is still the opportunity for vision and prophecy when one discusses the subject of transportation.

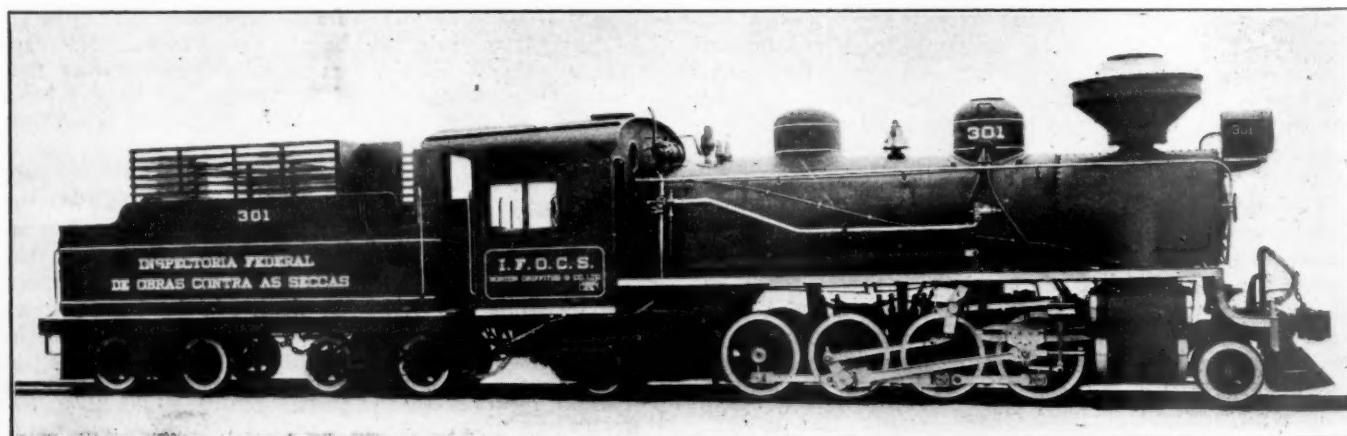


Type of Passenger Car Used on the Baltimore & Ohio in 1829

To a close student it is evident that the development of railroad equipment has not only kept pace with the traffic requirements of the country, but, thanks to the master car builders of America, has anticipated and is anticipating the necessities and demands of the future. The art of car building has progressed from the rough and ready cut-and-try methods of the old wooden car days to the execution of carefully developed engineering designs in steel construction. Experts in structural details and construction features are constantly on the job. American inventive genius is producing specialties that increase service, give added security and keep American railroading in the van.

H. C. Oviatt (N. Y. N. H. & H.): In consideration of the very fine talk and pictures presented here this morning at the convention, I move that we extend a rising vote of thanks to Mr. Carry.

(*The motion was unanimously carried.*)



Contractor's Locomotive for Irrigation Project in Northern Brazil, Built by American Locomotive Company

Training Mechanical Department Apprentices

Shop and School Instruction Essential—200 Santa Fe
Graduates Filling Supervisory Positions

By John Purcell

Assistant to Vice-President, A. T. & S. F.

THE GROWTH in industry and the great and rapid increase in demand for its products has made a corresponding increase in demand for skilled workmen, the class of workmen which only a well-defined apprenticeship can supply. There are not enough skilled mechanics to supply the demand today, nor have there been for the past 20 years. This is why some of the railroads have found it necessary to devise a modern, progressive plan for educating and training apprentices in their shops. The older method of employing a boy and turning him over to a busy foreman, whose primary duties were immediate output, affording him little time to care for a green, bashful boy, was very unsatisfactory and failed to accomplish needed results. Being left to their own resources with no one definitely responsible for their training, only a few of the more ambitious and resourceful boys survived and became good men; the majority fell by the wayside. It is evident since we specialize with various elements of a shop—a separate tool room for making and caring for tools, and central power house to provide power and lights, an accounting and timekeeping department to determine costs—that we should have a specialized plan for taking care of our young help that will provide a trained head and hand for our skilled work.

Today a boy over 16 and under 22 comes to us to learn a trade. We examine him as to his mental alertness, education, character, etc., and endeavor to learn whether he has natural fitness or liking for the trade he wishes to learn. We also have a surgeon examine him to be sure he is free from physical ailment or organic trouble which would make him unable to perform the work of a mechanic. Company, state, and federal rules of inspection, safety appliance laws, rules of interchange, etc., make it necessary that a worker be able to read a blue print intelligently and to interpret these rules with reasonable understanding. Many of the states have compulsory school attendance laws and in these days a boy of 16 years should have a well-grounded training in mathematics.

Shop Training and School Training

An apprentice training system should be composed of two supplementary branches, shop training and school training. The road with which I am connected has for 16 years conducted such a training course for apprentices and while for the first two or three years it was considered as an experiment, it has become a fixed part of our mechanical organization.

We have three general classes of apprentices, known

as regular apprentices, helper apprentices and special apprentices. Regular apprentices must be between the ages of 16 and 22, must be physically fit, have a common school education and be capable of working ordinary problems involving common and decimal fractions. Each is regularly indentured to serve four years, the necessary papers being formally signed by his parents or guardian, who obligate themselves to assist the employer in training the boy, by their parental encouragement and care. He is examined by the apprentice instructors as to his mental qualifications and alertness, and his employment completed by local master mechanic or superintendent of shops, with the approval of mechanical superintendent and supervisor of apprentices.

The apprentice is passing through a critical stage of life, from boyhood to young manhood, is easily influenced, habits quickly formed, and it is well that a strong but kindly hand guide his steps and direct his youthful energy and ambition in correct paths. Here is where the shop instructor proves his value. No time is lost by the boy in getting started. He is immediately put on productive work under the training and guidance of the apprentice shop instructor. If a machinist apprentice, he is immediately taken to a machine and the machine explained to him. He is shown how to fasten his work on the machine and what speed and feed to use, patiently and thoroughly instructed as to each machine, its parts, its functions, its

care and how it should be operated. He is made familiar with the purpose for which the piece of work is being made and the use to which it is to be put. Similar instructions are given him as to floor and bench work and all other work of his trade. A regular schedule of shop work is provided showing the number of months or weeks he is to be assigned to each class of machines or each class of floor or bench work. Likewise, with apprentices of other trades, each is given instruction and experience on each class of work of his trade.

The apprentice is never considered as a convenience nor assigned to common labor or regularly used as a helper. We make him feel that his chosen trade is the best possible selection he could make. We hold the instructor responsible for the boy's thorough training just as we hold the foreman responsible for the output of the shop.

For every 25 apprentices there should be a regularly assigned shop instructor whose sole duties should be the training of the apprentice. The shop foreman has little time to devote to a young apprentice boy and is prone to leave him on one job or machine. A good shop instructor is a good investment in any shop. Due to his instruction, better



John Purcell

work is done by the apprentice, there is very little defective work and an absence of tool breakage. There is a great advantage in being able to keep important machines going when the regular operator is absent, by placing an apprentice on the machine, who with the help of the instructor can successfully operate it. A good shop instructor will study each boy, weeding out the unfit, advancing the bright aggressive boy, and coaching the backward boy.

School Instruction

In connection with his shop training the apprentice should receive some theoretical instruction, so we have provided regular apprentice schools which the apprentices are required to attend four hours a week in two classes of two hours each, a total of 208 hours a year. Here the apprentices are taught mechanical and freehand drawing, shop mathematics, company and federal rules governing the care and maintenance of equipment, the company standards as to materials and practices, is given an opportunity for reading and studying desirable text books on mechanical subjects, and for a detailed study of injectors, lubricators, air brakes, steam heat, stokers, and other special appliances. Regular apprentices are paid their regular rate for time attending school. The company provides drawing boards, instruments, stationery, lesson sheets, models, charts, books, etc., free of charge, each apprentice being provided with a complete outfit for his use while attending this school.

Our apprentice school instructors are in general technically educated men who have also served apprenticeships in our shops. In addition to their duties as instructors they supervise the making of all shop sketches and drawings and look after special and technical work for the master mechanics. Each instructor is supplied with literature on new appliances, with which he must familiarize himself in advance of their application. We print our own lesson sheets in drawing and mathematics, which are bound in loose leaf form and kept constantly up to date. Upon completing this school course, the apprentice is not only able to read blue prints and working drawings readily and understandingly but can also make sketches and finished drawings. In fact, in addition to being a skilled mechanic he is also qualified for work as a mechanical draftsman.

The fate of an apprentice should not be left to any one man so we established what is known as the apprentice board, a body of men composed of the general foreman as chairman, the department or gang foremen under whom the apprentices work, and the apprentice school and shop instructors. These men meet once a month at stated times to pass on the progress of apprentices and discuss matters pertaining to their training. They go into each case carefully and thoroughly, strengthening the weak and encouraging the strong. In spite of all the care that is taken, there are times when we find a boy who is not making the progress he should. In such cases we endeavor to learn the reason; the boy is talked to and urged to greater effort. If it is found that he continues below the standard and does not take the right interest, he is tried on another trade and if he then does not develop he is dropped from the service. These apprentice boards serve a dual purpose, that of learning of the progress and ability of each apprentice and of making each member of the board study his men more closely and keep intimately familiar with the qualifications and progress of each individual under him.

Thorough experience is given all apprentices. Apprentices of the larger back shops are required to serve six months in roundhouse or at smaller outlying points and apprentices at smaller points are sent to larger shops where a more extended opportunity is afforded. Every effort is made to see that each apprentice is given full variety of experience in all the work of his trade so that upon graduation he may be a skilled, all-around mechanic who can execute and lay out any piece of work from any drawing furnished him.

Helper apprentices are selected from young men who have had two years' experience as helpers of the craft. They serve three years and are given the same shop instruction and variety of work given regular apprentices. They are not compelled to attend the apprentice school but are permitted to do so if they so desire. This apprenticeship provides opportunity for advancement of some of the most deserving helpers in our shops.

Special Apprentices

Special apprentices are graduates in mechanical engineering from colleges and universities. They are employed upon a personal interview by supervisor of apprentices and must pass the same medical examination as the regular apprentices. As they have a thorough technical education and generally have had some shop experience, this course is made shorter than that of the regular apprentice. They are formally indentured for three years. Their course in the shop is short and intensive: First year, general machine work; second year, floor and erecting work; third year, work of a varied nature, consisting of four months in the roundhouse, two months in the boiler shop, two months on freight car work, two months inspection and two months with the road foreman of engines. They are required to pursue a course of reading laid out by the management and to write a monthly letter bearing on the work they have been doing. The purpose of this special apprentice course is to supply the practical experience, without which the college man's technical education is of little value in railroad work. We now have some excellent material as special apprentices and are in the market for more of them.

A standard set of shop tools of the trade must be owned by each apprentice of that trade. The company provides an easy method of payment at wholesale prices and furnishes a tool box for their safekeeping. This insures uniformity and places each boy on the same footing.

Apprentices are encouraged to take part in athletics, clean sport and wholesome amusement aiding in the boy's development. Baseball, football, basketball, etc., are played in their regular season. The apprentices also have their musical societies, their social and debating clubs. We aim to make our boys not only first class skilled mechanics, but also good citizens, of moral character and right living.

Upon graduation or completion of apprenticeship, the apprentice is given a handsome diploma certifying that he has served an apprenticeship in the shops of this company, has completed the prescribed course in the apprentice school and has become a competent and skilled mechanic. This diploma is signed by the master mechanic or superintendent shops, the mechanical superintendent, the supervisor of apprentices and the chief mechanical officer of the system. Often the lettering on his diploma is made by the boy himself.

The Results

From 16 years' experience in this course of training, we have satisfied ourselves that this is the only method to pursue to keep our railroad supplied with first class mechanics. We have no industrial territory to draw on for men. Immediately upon inaugurating our present apprentice system we began to enjoy its benefits. It furnished skilled mechanics for our shops. Just prior to the war our largest shop had not employed a mechanic from the outside for two years. We were making mechanics as fast as we needed them. It gave us a flexible body of young men whom we could transfer to any point where men were needed due to any unusual rush of business. It furnished staff officers and inspectors and best of all, gave us an almost unlimited source to draw on for supervisory officers. Today with all the discouraging conditions of the past few years, we have over 200 of our graduate apprentices filling supervisory positions in our shops, from gang foremen to master mechanics, and a large number in important staff positions.

In establishing and properly conducting an apprentice system, there are several essentials for its successful operation:

- (1) Some individual who shall have general supervision in the selection of apprentices and their shop and school training.
- (2) Ample shop instructors whose sole duties are to train and direct the boys while in the shop.
- (3) An efficient school room instruction where the theory of the trade will be taught the apprentices by capable and intelligent instructors.
- (4) The backing and support of the management.

The head should prepare necessary rules to insure a standard method of employing, standard lesson sheets for schoolroom work, a regular fixed schedule for shop work to avoid partiality and to insure an equal opportunity to each. He should see that competent instructors are employed and should keep a faithful record of all apprentices while serving their time and an equally complete record of those who have completed the course and have been assigned to regular work and a list of all graduates available for promotion. You must not expect an apprentice training system to go on and give results without some one whom you can depend on to carry out its purpose.

Railroads should make and promote their own men and not depend on other roads to furnish them. The thorough training of apprentices should have the backing and support of the chief mechanical officer, for it insures him of having not only skilled mechanics for the shops but of having men trained and qualified to fill any position of a supervisory nature that may become vacant in his department. As a matter of fact, every officer owes it to his company and to his superior officer to have men trained and qualified to fill any position that may arise. He should have some one under him thoroughly qualified, who is familiar with the property, trained and ready to take his position whenever the necessity arises.

Discussion

G. M. Basford: He who makes something in steel, stone, iron, wood or wire, creates an inanimate thing which may or may not be used as it should be used for the benefit of mankind. He who has an opportunity to help develop a mind, a man, or a power with possibilities far beyond those of the source they come from does more. You do not know what man you may be making. A word, a suggestion, a dynamic thought given to some young man, matures in an instant. Somebody did this to you some years ago, somebody did this to Mr. Purcell. Who was it?

Probably most men have forgotten who put the dynamite under them to wake them out of the ordinary and to compel them to realize what they owe to somebody else. I do not believe there is one man present who does not possess the ability to place the dynamite under his boys, but a good foundation is needed for this force and it is necessary to qualify to produce it.

There is nothing I take more pride in than the success of the plan of the Atchison, Topeka and Santa Fe, and its execution, for helping young men to find themselves and to prepare them for the most useful, honorable work in the world. John Purcell is the center of this scheme and if any one fails to get the spirit that inspired him to do this great work, he will fail to respond to one of the greatest inspirations ever made available to American railroad men.

Why the Santa Fe Plan Succeeded

Why is the Santa Fe scheme a success? The chief executive backed it from the start. When this plan in embryo was presented to E. P. Ripley, of honored memory, Mr. Ripley said, "We will do it." It was done.

Knowing that the cost might sometime be mentioned, Mr. Ripley was asked how he felt about the cost. He said, and he continued to say, "I shall never want any statement as to the cost of training apprentices, feeling that the true value of thoroughly trained and skilled men can never be measured in dollars and cents." Without the support given by Mr. Ripley and by W. B. Storey, which has never wavered, this accomplishment could not be recorded. But,

bear in mind that the results have only just begun to appear. This great work pyramids; the best is yet to come. Who knows what any one of these young men may do and what any one of them may become?

Go to the real root of the matter. Get the appeal to the chief executive of the road. Show him that a successful plan is available and get him to act forcibly, quickly and for permanence. Show him that we are soon to hand our duties, our responsibilities and our opportunities over to others and that it is up to us to do this right.

The Spirit Back of It

Then you need a John Purcell with the inspiration that came to him when a workman in the shop. Then he was in position to see the need of the training of men. When first put in charge of men at Fort Madison 23 years ago, he began the training of men. He trained them in the shop. He taught the school himself and provided books and drawing instruments at his own expense. This spirit is needed. Then you need what Frank Thomas and his devoted men have done to make a plan, to carry it out and to educate thousands of young men who became their loyal, intimate friends.

Mr. Purcell plainly states a need and shows how he has met it for 16 years. But this is not all. Mr. Purcell utters a warning which every executive must heed or fail in the most vital thing of official life. What are we doing to compare with graduating 1925 apprentices in 16 years? What are we doing that compares with the production of 239 apprentice graduates holding official positions in one organization? Who else but the Santa Fe won the Ryerson scholarship four times running? This meant that these boys qualified to take college examinations. Who but John Purcell was in position to supply 300 skilled workmen overnight, to support our boys and carry on in the World War?

The author has told us about his recruiting and training plan, but he does not tell us, nor does he need to tell us, how he imbues his organization with such abounding loyalty to him, to the organization and to everything that "Santa Fe" stands for. This, gentlemen, is fundamental. Loyalty to his men and their loyalty to him is the biggest thing of all. No wonder he succeeds.

The future of American railroads depends upon the training of loyal men and their promotion more than it depends upon any one thing. Sixteen years from today somebody else will have your job. What are you doing to prepare him?

College Men as Apprentices

Professor L. E. Endsley (University of Pittsburgh): The work of educating young men, which I have been in most of my life, is a most enviable job. There is nothing more pleasant in the world than to open the eyes of a boy and give him inspiration. We as educators—and all of us in the railway game should be educators in our line—should make the boy love his work. That is all you need for him to be a successful railroader, or a successful man in any walk of life.

During the last few years, boys leaving college have not been attracted by railroad work. Very few boys are entering the railroad departments of our colleges today. I wonder if the railroads realize the benefit that may come from a technically trained boy entering railroad work. Mr. Purcell said in his paper, "We have some very good special apprentices," meaning college graduates, "and we hope to get more." I wonder if the railroads of the United States appreciate what has been done for them by the special apprentices.

Apprentice Training on the New York Central

C. W. Cross (N. Y. C.): On the New York Central Lines, apprenticeship methods are similar to those on the Santa Fe, both plans following closely the suggestions made by George Basford in a paper before the American Railway Master Mechanics' Association in 1905. The system was inaugurated on the New York Central Lines in 1906 and has continued with increasingly beneficial results. Many graduate apprentices are still in the service as workmen or supervisory officers. Officers have declared that preference may well be given to graduate apprentices when selecting men for positions as foremen. Unlike the Santa Fe, the New York Central Lines are located in a densely populated industrial district; therefore certain variations in the plan are necessary.

We also have three grades of apprentices. Regular apprentices are boys 16 to 21 years of age, having a high school education or equivalent, and in good health. Schools are maintained at the shops six mornings a week. Attendance is compulsory and under

pay, but the minimum requirements are not severe. Many boys who have not had much early education still have good intentions and respond to a genuine opportunity to improve their condition by attending the schools. The shop instructor supervises the movements of the apprentices in the shops, gives them instruction in the proper methods to follow and arranges for them to be moved in accordance with the schedule established for each trade. The shop instructors do not assign work, but instruct apprentices in the work which the department foreman has assigned to them.

The helper apprentices are young men 21 to 30 years of age, in good health, who have had two or more years continuous experience as helper in the shop from which application is made. They serve a three-year apprenticeship course. Attendance at the school is optional but many of them do attend.

The special apprentices are young men 18 to 26 years of age, who are college graduates in mechanical engineering, in good health. They are placed on the regular work in the shops and assigned to special work on tests, and selected duties as required. These men do not attend the shop schools.

We do not promise anything for the future, but from the fact that many men now occupying good positions in the service are graduate apprentices, it may be said that the railroad service offers as good opportunities for the future as any other line of work.

In making selection of apprentices, the sons of employees are preferred, although others are also taken. This plan results in noticeable good will and helps materially to increase the bond of mutual interest between the company and the employees.

Leaders From the Rank-and-File

It is from the rank-and-file that we always have, and always will, develop leaders. The best policy is to encourage ambition in the large group of men on whom we must rely for superior performance of duty. The spirit of the service should be that everyone is to make his place in the organization in competition with everybody else. This method will develop loyalty and co-operation which will be mutually beneficial and profitable to the company and the employees.

This plan of apprenticeship is not philanthropic, but is a profitable business investment.

Making Railroads Attractive to College Men

J. J. Tatum (B. & O.): Professor Endsley has referred to the attitude of college men towards the railroads. He failed to say, however, that some of the people of our country have failed to encourage the progress of the railroads. In fact, they have done almost everything to tear down the greatest institution that this country has ever had placed in it.

This country has only progressed to the extent that the railroads of this country have progressed. What we want to stop and what every boy who is in college wants to help to stop, what every college professor wants to help to stop, is adverse legislation against railroads. Leave the railroads alone for a while. Let them work out their own problems and there will be more boys in colleges that will aspire to the railroad business. Your son perhaps may be going to college and may have asked you whether there was an opportunity for him on the railroads. Haven't you stopped seriously to think whether you would advise him to go into railroad service because of this adverse legislation? I ask the help of every railroad man, every college man, every professor and every boy today that is going through college to help stamp out this propaganda against the railroads. Leave them alone and they will become institutions that the college boy will aspire to become a part of.

F. W. Brazier (N. Y. C.): There is one element that holds us back from putting in apprentices in our shops. I have been in the service for 47 years. I have been approached time and time again by men to take their boys in and teach them the trade. I am an old-fashioned fellow. That is the way to get men. If you want to get loyal men, train up the men right in the work of the railroads. Make and promote your own men. One of my pleasant relationships with my men is that I have always had a man behind me, near me, a little more competent than I was to take my place.

F. M. Graff (Erie): Mr. Purcell's paper gives all that we need fundamentally to establish and maintain apprentice instruction. The detailed course on the Santa Fe, with which we are very familiar on the Erie, leaves but very little to be desired. We have drawn extensively from the experience and taken advantage of the money that the Santa Fe has spent in the instruction of its ap-

prentices since 1908. There is one thing that those railroads which have not instituted a regular detailed course of apprentice instruction do not understand, and will not understand until they get into it, and that is that the course must be systematic and it must be maintained.

We should include in our apprentice instruction an elementary course of economics. Then, when our young men graduate into the ranks of mechanics they will have that basic knowledge of the common fundamental facts of life and business that are necessary if we are to progress and go along in peace and prosperity.

Chairman Coleman: It seems to me you are developing something now which Mr. Purcell should have included in his paper—that there could be developed through this Mechanical Division men qualified to represent you in Congress. (Laughter).

More About College Men

Professor Rubenkoenig (Purdue University): I am very proud to say that I am a Santa Fe graduate—about 18 years ago. The special apprenticeship system was not thoroughly developed at that time, but I have had occasion since then to be in more or less contact with it.

Following up what the speaker mentioned a while ago about the colleges teaching our students to look after adverse legislation, that has been my purpose throughout all the years that I have had the students at Purdue University. I am only in contact with them, however, for one year, as seniors, but we are sending out this year seven young men who I think have the right attitude towards the railroads. One of these men in particular, I have in mind, has finished the regular apprenticeship course and was a roundhouse foreman before he came to the university; I have no doubt about his future position in the railroad world.

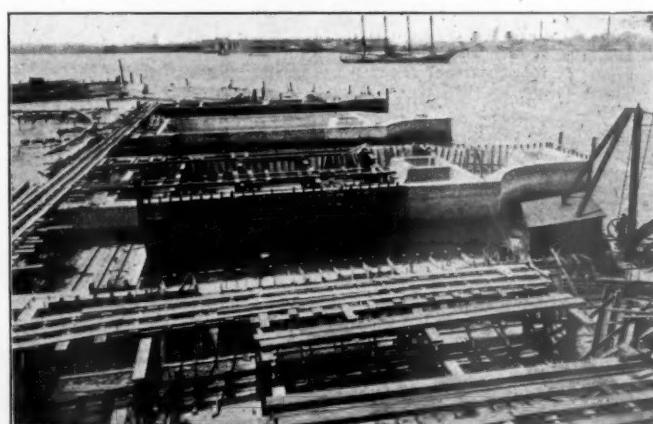
We were criticized more or less in an editorial—I have forgotten the exact words—about the hieroglyphics of railroading, but I wish to say that if that editorial writer could see the contents of our course he would agree that we do teach some of the A B C's of railway mechanical engineering.

Weed Out Unsuitable Boys

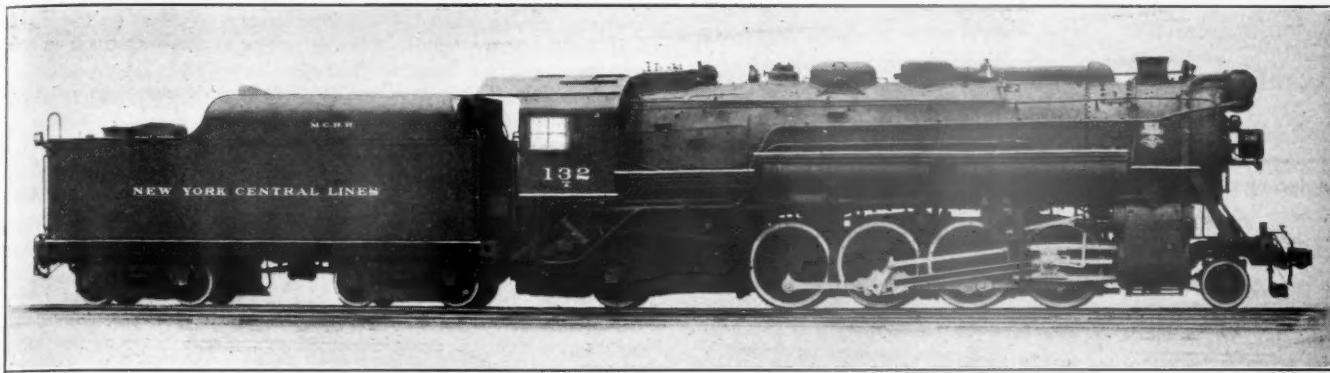
W. J. Bohan (Northern Pacific): Many engineering colleges today recognize the necessity of weeding out men that are not fit and that do not have the proper qualifications. It also is recognized in other colleges besides engineering colleges. I think the same thing should be done with apprentices. You may get an apprentice on the railroad and you keep him submerged for four years, and he never will make a mechanic or even an executive on a railroad (laughter).

Now, that may sound like a joke but it is a fact. About the first thing they ought to do with an apprentice is to uncover him and see if he is any good for railroad work. If he is not any good, then in the interest of the railroads, and in the interest of the man that is trying to be an apprentice, take him out of the service; tell him he is unfit for it, and advise him to go back to the farm or some other place to which he is suited.

H. C. Oviatt (New Haven): *I move that a vote of thanks be extended to Mr. Purcell for this most wonderful paper. (The motion was carried.)*



Foundation for Ferry Slips of P. & R. New Terminal at Camden, N. J.



Mikado Type Locomotive Used on New York Central Lines, Built by Lima Locomotive Works.

Report on Locomotive Construction

Formulas for Tractive Power, Stokers, Feedwater Heaters, Lubricators and Details of Construction Considered

DURING the year the committee has given consideration to the following subjects: Tractive powers for mallet locomotives, locomotive rods for heavy power, use of extended piston rods and minimum size of piston on which they shall be applied, hydrostatic and force feed lubrication, means of taking up driving wheel lateral, mechanical stokers, feedwater heaters, exhaust steam injectors, and crosshead connection of piston rods.

The committee will continue its study of standardization of taps and dies and rail stresses under locomotives and make report next year.

Tractive Power of Mallet Locomotives

The formula now in use for a simple locomotive gives only a close approximation of the actual tractive power, because of variation in maximum cut-off, back pressure, internal friction, etc. A uniform formula for the Mallet locomotive also will give only a close approximation of the actual performance.

There are two general types of Mallet locomotives: Four cylinder simple, and four cylinder compound.

The following symbols apply to all formulas given:

C = Diameter of high pressure or simple cylinder in inches.

c = Diameter of low pressure cylinder in inches.

S = Stroke in inches.

P = Boiler pressure in pounds.

D = Diameter of driving wheels in inches.

H = M. E. P. of high pressure or simple cylinder in pounds.

E = M. E. P. of low pressure cylinder in pounds.

R = Ratio of cylinder volumes.

K = A constant—.85 for 90 per cent cut-off locomotives and .75 for 50 per cent cut-off locomotives.

Q = PK = Total M. E. P. in cylinders.

T = Tractive power in pounds.

Of the values of "K" given above, the first has been generally adopted for simple locomotives having approximately 90 per cent cut-off. The second value, that for locomotives having approximately 50 per cent cut-off, is taken from results obtained with the Pennsylvania class I 1s (2-10-0) locomotive. Each piston valve bushing of these locomotives is provided with an auxiliary steam port $\frac{1}{8}$ in. by $1\frac{1}{2}$ in. in size and having $\frac{1}{4}$ in. steam lap. While the steam which passes through the auxiliary ports has an effect on the mean effective pressure, it is believed that the constant .75 may be used for any locomotive having approximately 50 per cent cut-off.

The four cylinder simple is essentially nothing more than two simple locomotives with but one boiler. Therefore, the tractive power of this type of locomotive is double that of the simple locomotive, or

$$T = \frac{2 K P C^2 S}{D}$$

which becomes— $T = \frac{1.7 P C^2 S}{D}$ for 90 per cent cut-off locomotives, and $T = \frac{1.5 P C^2 S}{D}$ for 50 per cent cut-off locomotives.

The four cylinder compound is usually equipped with a device by means of which the locomotive can be operated as a simple locomotive at certain times. Under this condition the tractive power of the locomotive would be

$$T = \frac{(H C^2 + E c^2) S}{D}$$

In a properly designed compound locomotive, it is the intent that the piston pressures will be equal. Therefore, we may assume that the mean effective pressures vary inversely as the squares of the cylinder diameters, or

$$\frac{H}{E} = \frac{c^2}{C^2} = R \quad (1)$$

Now the sum of the mean effective pressures of the high and low pressure cylinders will be equal to the total mean effective pressure, or $H + E = Q$ (2)

Substituting value of H from formula (2) in formula (1), we have

$$\frac{Q - E}{E} = R \quad (3)$$

$$\text{From which } E = \frac{Q}{R + 1} \quad (4)$$

The tractive power of the low pressure cylinders is

$$T = \frac{E c^2 S}{D} \quad (5)$$

Substituting value of E from formula (4) in formula (5), we have

$$T = \frac{Q c^2 S}{(R + 1) D} \quad (6)$$

Since we have assumed equal power for the high and low pressure cylinder, the tractive power of both pairs of cylinders is double that of the low pressure cylinder, or

$$T = \frac{2Qc^2S}{(R+1)D} \quad (7)$$

$$\text{which becomes } T = \frac{1.7Pc^2S}{(R+1)D} \quad (8)$$

for locomotives with approximately 90% maximum cut-off, and

$$T = \frac{1.5Pc^2S}{(R+1)D} \quad (9)$$

for locomotives with approximately 50% maximum cut-off.

For comparison, the proposed formulae are given in connection with other formulae in general use, all formulae given being for four cylinder locomotives, except as noted.

	Tractive power	Simple or compound	Approximate maximum cut off, per cent ratios	Cylinder per cent ratios	Authority
1	$T = \frac{1.7Pc^2S}{D}$	Simple	90	...	Proposed by sub-committee.
2	$T = \frac{1.5Pc^2S}{D}$	Simple	50	...	Proposed by sub-committee.
3	$T = \frac{1.5Pc^2S}{(R+1)D}$	Compound	90	All	Proposed by sub-committee.
4	$T = \frac{1.5Pc^2S}{(R+1)D}$	Compound	50	All	Proposed by sub-committee.
5	$T = \frac{1.2Pc^2S}{D}$	Compound	90	2.35-2.40	Baldwin Loco. Works.
6	$T = \frac{1.7Pc^2S}{(R+1)D}$	Compound	90	All	Baldwin Loco. Works.
7	$T = \frac{Kpc^2S}{D}$	*Compound	90	*	American Loco. Co.
8	$T = \frac{1.6Pc^2S}{(R+1)D}$	Compound	90	All	C. R. Henderson Loco. Operation.
9	$T = \frac{2Pc^2S}{3D}$	Two cylinder compound	90	...	Interstate Commerce Commission Circular No. 22.
	$T = \frac{P(\frac{2}{3}C^2 + \frac{1}{4}c^2)S}{D}$	Compound	90	...	

*See Table 1 for value of K.

TABLE NO. 1—CONSTANTS K
Ratio of L. P. to H. P. cylinder volume

Per cent cut-off H.P. cylinder	2.2	2.3	2.4	2.5	2.6	2.7	2.8
90.....	....	....	.571	.557	.542	.528	.513
89.....	....	....	.565	.550	.526	.521	.507
88.....	....	.573	.559	.543	.529	.515	.500
87.....	....	.567	.552	.537	.523	.509	.494
86.....	.575	.560	.546	.531	.517	.502	.489
85.....	.570	.555	.540	.526	.511	.497	.483
84.....	.564	.550	.534	.520	.506	.491	....
83.....	.559	.544	.529	.515	.500	.486	....
82.....	.553	.541	.524	.510	.496	....	....
81.....	.548	.534	.520	.505	.490	....	....
80.....	.543	.531	.515	.500	.486	....	....

Main and Side Rods

A strap end main rod of tapered fluted section with heavy brasses and as narrow flanges as possible, setting up wedge located in front of the crank pin with single nutted bolts riveted over, with one grease cup, composition bronze bearings each end and approved adjusting feature at front end is what is wanted in a main rod for heavy locomotives or a solid back end of main rod with floating bushing. All details should be made as light as possible.

The same conclusion applies to side rods, except that main parallel connection may be equipped with floating bushing. They should have ample side clearance at knuckle pins with solid oil cups and single or castle nut for knuckle pin with cotter, or a lock nut. A tapped plug at top and bottom, or some similar design or plug, sufficient to prevent bushings from turning. We consider both arrangements good practice. Knuckle pins should be amply large and hollow to lighten them.

All offsets should be reduced to the minimum and special shapes

eliminated except when there is interference. Collars on the inside of all bushings are helpful when it comes to pressing them in and checking the offset faces of the rods.

No welding of any kind to be used in fastening keys, wedges, etc., on main and side rods.

Extended Piston Rods

To obtain information as to what extent extended piston rods were being used, a questionnaire was submitted and replies have been received from 93 roads representing an ownership of 52,283 locomotives. Seventy-six roads, 81.7 per cent of all reporting, are not using extended piston rods. The 17 roads, 18.3 per cent of all reporting, which are using extended piston rods, own 21,684 locomotives, and of this number 2,692 or 12.4 per cent of the locomotives operated by them, and 5.1 per cent of the total number of locomotives operated by all roads reporting, have extended piston rods. In this connection, 875 of the 2,692 locomotives equipped with extended pistons are owned by one road. These figures do not include new locomotives on order. The road having the 875 locomotives equipped has on order an additional 533, which will then make a total of 17.7 per cent of locomotives owned by that road.

Twelve roads report they have either removed the extended rod or will do so. One road reports removing them from 210 locomotives, and one from 110.

The smallest cylinder reported equipped is 19 in.—the maximum, 44 in. diameter. The largest cylinders operated without extended piston rods are: 40 in. on five roads, 41 in. on four roads, 42 in. on four roads and 48 in. on one road.

The extended piston rod in general use is the outside crosshead supported type with packing gland. Only two of the 17 roads have the bronze sleeve and sheath type.

A majority of the replies (46 roads) indicate their belief that the extended piston rod is of no benefit unless it keeps the weight of the piston free from the cylinder walls—seven indicate that there is a certain value other than freeing cylinder walls of piston weight.

Seventy-five roads using cylinders from 19 in. to 48 in. diameter without extension rods report no unusual trouble. Four roads report troubles with cylinders from 19 in. to 34 in. diameter.

The question as to whether there is any practical limit to the size of piston which may be used without extension rod is answered as follows: Thirty-two roads believe there is no limit, while 15 say that there is, and would apply them to cylinders over certain sizes.

The committee finds from its investigation that there is a diversity of opinion as to the advantages from the use of the extended piston rod. However, it is the conclusion that the large majority of the railroads of this country do not consider there is sufficient merit in the extended piston rod to warrant the use.

Although there are certain roads which have used the extended piston rod for a number of years, and the advantages and service which they have obtained have influenced these roads to specify the extended piston rod on new equipment on order—an approximately equal number having used the extended piston rod, have or are now discontinuing the use of same, and are removing them.

It is presumed that the wide divergence of experience and opinion is due to the marked differences in operating conditions, including such features as superheating versus saturated steam, quality of boiler water, lubrication and materials used for cylinder walls and pistons.

The character of boiler water which has a direct bearing on lubrication is of more importance on saturated than on superheated locomotives, as the carrying over of water and solids into the cylinder, which is more likely to occur on saturated engines, has an important bearing on wear, and, therefore, the consideration of extended piston rods.

Again, some roads operate superheated locomotives either with drifting valves or require their engineers to crack the throttle and work steam while drifting. This has important bearing on lubrication and wear, and again reflects on the question of extended rods.

The materials used for cylinder walls and piston heads and rings also exercise a deciding influence on wear. In this connection, quite a few roads are now bushing cylinders with semi-steel bushings as the regular standard, while other roads do not bush except after excessive wear of the original cylinder barrel. One road abandoned extended piston rods a number of years ago, and is

now operating pistons up to 41 in. in diameter made of cast steel and surfaced with phosphor bronze.

Perhaps the most important feature in connection with extended piston rods for large cylinders is that of lubrication. Some roads have relied upon the extended piston rod as a relief from certain existing evils, while the majority of roads have apparently controlled to a sufficient extent the same evils which are avoided more or less by the extended rod.

It cannot be denied that there are difficulties wholly incident to the use of extended rods. Whether these difficulties are more or less than the difficulties avoided is uncertain, and this committee finds itself unable to make a definite recommendation for or against extended rods.

Hydrostatic and Force Feed Lubrication for Cylinders and Steam Chests

There has been no rapid development in the extension of the force feed system of lubrication to locomotives although the adaptability of the force feed lubricators to locomotive practice as indicated by a few scattered installations has been under investigation for a number of years. In the introduction of the force feed lubricator to locomotive service, it was soon discovered that there were problems in design such as ruggedness and dependability that had not appeared in connection with the use of the same type in stationary practice. Opinions differ as to the relative merit of force feed and hydrostatic lubrication.

A questionnaire was sent to the 12 roads reported as having force feed installations. Aside from obtaining a record of the number and types of the different force feed systems in service and the method of application, little definite information was available. It appears that there are no records as to the relative merits of the two systems of lubrication as indicated by cylinder and valve packing ring wear or the relative consumption of lubricant.

It may be of interest to indicate the roads replying to the questionnaire showing the type and number of force feed lubricators they have in service and the location of the oil delivery:

Lubricators					
Road	System	No. of feeds	No. of	Location of oil delivery	
C. & E. I.	Schlack	1	2	Outside steam pipe.	
C. & N. W.	Schlack	2	2	Outside steam pipe.	
	Madison-Kipp	2	2	Outside steam pipe.	
	Nathan Mfg. Co.'s Friedmann	6	6	Outside steam pipe.	
C. M. & St. P.	Schlack	1	2	Outside steam pipe.	
D. L. & W.	Madison-Kipp	2	2	Main steam pipe.	
	McCord	2	2	Main steam pipe.	
Grand Trunk	Had Intensifore a d Wakefield, Beth now removed	5	5	Outside steam pipe and top of cylinder barrel	
N. & W.	Schlack	1	2	Top of cylinder barrel.	
	McCord	5	2	Mallet L. P. cylinders.	
	Goodfellow	1	4	Steam pipe.	
	Madison-Kipp	1	2	Steam pipe.	
Pennsylvania	Nathan Mfg. Co.'s Friedmann Type FSS	1	6	Steam pipe.	
	Nathan Mfg. Co.'s Friedmann Type DV	1	6	Steam pipe.	
	McCord	50	2	Steam pipe.	
	Schlack	50	2	Steam pipe.	
Southern Pacific	Nathan Mfg. Co.	4	4	One to each steam pipe and top of cylinder barrel.	
Union Pacific	Madison-Kipp	4	4	One to each steam pipe and top of each cylinder barrel.	
Erie	Schlack	4	4	Bottom of cylinder.	
	Madison-Kipp	4&6	4&6	Bottom of cylinder.	
	Nathan Mfg. Co.	4	4	Bottom of cylinder.	

The three systems of force feed lubrication that have received any measure of recognition by the railroads are the Nathan Mfg. Co.'s Friedmann, Madison-Kipp and Schlack (formerly identified as McCord).

It is the thought of the committee that, should the subject be continued for further consideration, it would be well to outline a test program and solicit the railroads having force feed lubricators to apply them to locomotives in conjunction with the hydrostatic system, thus providing for force feed lubricators on one side and hydrostatic lubrication on the opposite side, and keep a record of service conforming to the outline suggested.

Taking Up Driving and Truck Wheel Lateral

From the information we have been able to obtain no patented devices have been applied in quantity and little is known of the service, application and maintenance costs. A number of different adjustable or stationary hub plates have been tested and in some cases used to a considerable extent, but on account of some defect, their use has not been generally extended.

The lateral in locomotive driving boxes is taken up on practically all engines under construction at this time, either by attaching the liner to the wheel hub or to the face of the driving box. Most applications to the driving boxes are made by pouring the liner on the face of the box and then finishing. The majority of applications made are by finishing the liner, fitting it into a recess in the wheel hub and pinning it in place with bronze plugs driven in. As a general rule the liners are made of solid bronze, but a few cast iron liners are applied, and some bronze liners having white metal inserts.

In the absence of conclusive information as to the reliability of the various patented devices for taking up driving and truck wheel lateral, and in view of the satisfaction evidently obtained either by pouring or pinning bronze liners to the face of the driving box or wheel hub, as evidenced by their almost universal use, it would seem that until some better device is developed that the liner poured or pinned to the driving box face or driving wheel hub is the best means of taking up lateral.

Mechanical Stokers

The subject of mechanical stokers has been before the Association since the 1905 convention. It is the thought of the committee that it might be amiss to briefly review the history of the development of the mechanical stoker as applied to the locomotive and point to a number of interesting and valuable features in connection with the construction and operation, adding thereto the impressions as to what should be the further handling of the subject.

(The report includes a very complete resume of locomotive stoker development and of previous committee reports together with many comments thereon. Reference also is made to other papers and investigations.—Editor.)

The number of stokers of each type that are in service or on order as of April 1, 1923, are shown in the accompanying table:

NUMBER OF STOKERS AS OF APRIL 1, 1923			
Manufacturer	In service	On order	Total
Elvin Mechanical Stoker Company—			
Type A.....	5	10	15
Type B.....	247	102	349
			364
Hanna Stoker Company—			
Type V-H.....	109	0	109
Type H-2.....	8	57	65
Type S-1.....	34	0	34
			208
Locomotive Stoker Company—			
Type, Street.....	1,458	0	1,458
Type, Duplex.....	4,142	772	4,914
			6,372
Standard Stoker Company—			
Type A-1.....	510	0	510
Type A-1M.....	102	0	102
Type DuPont.....	65	0	65
Type, DuPont Simplex.....	34	59	93
			770
Grand total.....			7,714

Longer experience with mechanical stokers has led the committee to the conclusion that while a stoker designed to handle run-of-mine possesses merit, this feature might well be sacrificed for further improvements in design and ability to perform the stoking operation and the exploitation of machinery for the preparation of fuel at coaling stations or wherever it might best be handled. This preparation should include not only crushing the coal so that it may be satisfactorily handled on the stoker without further preparation but also the grading to the extent of removing, as far as warranted, the finely divided material which would result in materially increasing stack losses.

The committee has been much impressed with the idea that the classification of coals for stoker service cannot be definitely established by the chemical properties alone, but the physical characteristics also must be taken into consideration. The importance of

this increases in proportion to the quantity of finely divided material carried in the fuel. The determination of the physical characteristics should cover the available range of fuels to enable the establishment of the relative value of fuel per ton mile. By such a method the purchaser would be able to determine the price at which a given grade should be purchased. Such a range of values established for a road or the fuel from some particular field would not necessarily be applicable to other roads and this rating would probably have to be developed by individual roads.

It is thought that this latter phase of the subject now becomes paramount. In view of the enormity of the stack loss which is a direct measurement of the physical nature of the fuel so apt to be lost sight of, perhaps as a condition necessarily incident to stoker operation, it is recommended that the subject be assigned to the committee handling the locomotive fuel question and that the subject be investigated with the view of securing the best suggestions that can be offered for the saving of fuel by selection and preparation. It is well recognized that the preparation may not be so readily worked out and for many reasons, including local conditions, which might carry possibly the question as to the extent that the stack losses might be offset by relative cost of fuel and also what disposition might profitably be made of material screened from the coal. The material screened from the coal has value and should be used profitably for by-product plants, manufacturing industries or stationary power plants using powdered fuel or hand-fired yard service.

Feedwater Heaters

The increase in the number of feedwater heaters applied each year since 1920 shows considerable interest in this device. Reports indicated that there were 11 locomotive feedwater heaters in service in 1920, about 54 in service, or on order, in 1921, and 197 in 1922. Replies to the questionnaire and reports from the manufacturers this year indicate that there are 997 heaters in service and on order, as shown in the table. Practically one-third of the locomotives built and ordered during the past year are to be equipped with feedwater heaters.

Replies indicate that all the heaters are either those of the open type manufactured by the Worthington Pump & Machinery Corporation, or the closed type manufactured by the Superheater Company. We understand, however, that there are three other types which are either now in service or have been in service experimentally—one of the Foster-Thompson exhaust gas heater, one of the Skinner (also an exhaust gas heater), and three of the Caille (a closed type low pressure heater).

	Open type		Closed type		Total	
	In service	On order	In service	On order	In service	On order
N. P.	0	4	0	4	0	8
A. T. & S. F.	2	0	2	61	4	61
M. C.	0	0	11	0	11	0
C. V.	0	0	1	0	1	0
S. P. (Pacific)	58	100	2	0	60	100
S. P. (Texas)	4	9	2	0	6	9
F. W. & D. C.	1	0	1	0	2	0
L. I.	1	0	1	0	2	0
St. L. S. F.	0	2	2	0	2	2
C. & S.	1	0	1	0	2	0
P. & R.	1	0	0	0	1	0
N. Y. N. H. & H.	0	0	16	14	16	14
N. C. & St. L.	1	0	1	0	2	0
N. Y. O. & W.	0	0	0	0	0	0
N. & W.	1	0	0	0	1	0
K. C. S.	0	0	1	0	1	0
P. R. R.	104	375	0	0	104	375
D. & M.	3	5	0	0	3	5
T. & P.	0	0	8	0	8	0
C. R. I. & P.	1	6	0	0	1	6
N. Y. C. & St. L.	1	0	0	0	1	0
C. & N. W.	2	0	2	0	4	0
E. J. & E.	0	0	1	5	1	5
C. N.	1	36	19	26	20	62
M. K. T.	2	0	2	0	4	0
C. R. R. of N. J.	0	0	6	26	6	26
I. C.	1	0	1	0	2	0
C. C. C. & St. L.	0	0	49	0	49	0
Erie	0	5	5	0	5	5
Total	185	542	134	136	319	678
Grand total	185	542	134	136	319	678

A questionnaire was again submitted this year and a summary of the replies indicates considerable progress in the development. The report this year must be considered as a progress report, as many of the roads have only a few heaters in service and many of these have only been in service a short time.

[The replies, in a very condensed form, showed the following: Seventeen roads are not considering the application of additional heaters, while

nine roads are considering the application of 590 additional heaters, most of them being of the open type.

Most heaters have been applied to heavy freight and passenger locomotives with a few in suburban and switch service. The fuel used on six roads is oil, and on 19 roads, coal. All kinds of water and operating conditions were reported.

Twenty roads reported no reduction made in size of exhaust nozzle on locomotives equipped with heaters with which five roads made slight reductions.

A wide variation in preferred location of the heater was reported.

In regard to the relative amount of boiler scale, eleven roads reported no change noted, two a reduction, and nine not sufficient time to observe results.

In methods of cleaning the heater and in the costs, the replies showed wide variations. Similar variations appear in the reported costs of maintenance.

Several roads reported trouble from the heater system freezing up, but it would appear that this could be remedied by locating drain connections at low points and applying circulating pipes.

Most roads return condensate from closed type heaters to the tender.

Several reported trouble with boiler checks. A number reporting no trouble, advise that larger or special checks are required and that the left of the valve should be reduced to 3/16 in. or less. Nine roads reported trouble with closed type heater tubes leaking, and eleven reported no trouble. Sixteen roads reported having had pump troubles and ten roads no trouble. But few reported engine failures due to the heater.

Five roads reported that oil separators were not used with open type heaters, and 20 roads reported using them with closed type heaters.

Twenty per cent of the roads reporting had found traces of oil in the boilers. Only one reported any injurious condition. One road reported a tendency to foaming after a long run, 600 miles. Reports showed that the period between washing was the same whether heater was or was not applied. Reports also indicated no change in length of time between flue renewals.

Twelve roads found no difference in control of water lever by heater pump or by injector, while nine reported that regulation was superior to injector.

Twenty-two roads favored the application of only one injector when a heater was used, and two roads favored retention of both injectors.

Most of those reporting considered using the pump while standing or drifting, a practice that might result in injury to the boiler. The use of top checks on locomotives having heaters was preferred by a number of roads.

Some roads have found a reduction in superheat on heater equipped locomotives.

Reports as to economies showed saving of from 8 to 15 per cent for locomotives having heaters, as compared with those having injectors only.

Eight roads stated that the capacity of the heater should be the same as that of one injector; seven thought that it should be slightly greater, while ten replied that capacity should be from 10 to 100 per cent greater.—EDITOR.]

One road reported taking steam from the main steam pipes of locomotives for use on heater for the following reasons: First—To get superheated steam for use on pump. Second—with the high temperature of feed water it was found that unless the pump throttle was closed before the main engine was shut off, relieving the heater from the back pressure caused by the exhaust steam, it would cause the water in the heater to vaporize, thereby causing pump to race, until sufficient cold water had pumped into the heater to reduce the temperature below boiling point. While no damage was apparent from this racing, it was self-evident that it was not desirable, and that unquestionably, in time, damage would result to either pump valve or packing. Third—to get the best result from the heater, it is desirable that same be started immediately when the engine begins to work steam, and also that it be shut off as soon as main engine is shut off, as otherwise the temptation to pump cold water in the boiler was ever present, which is a most undesirable practice. Combining the steam supply for main engine and pump was thereupon decided upon, and the scheme has proven most satisfactory.

As an example of what can be accomplished by this method of feeding, and with proper training of engineer, engines in passenger service go over the whole division of 125 miles, making their regular stops, without the engineer having once changed the adjustments on pump throttle valve, the pump starting automatically as soon as the main throttle was opened, and stopping when same was closed. A remarkable fact in connection with these runs, and one that hardly seems reasonable, is that the water level only showed a variation of $\frac{1}{2}$ in. from the start until the finish of the run.

Exhaust Steam Injectors

A report from the Specialty Company handling the one type of exhaust steam injector used in this country indicates that there are now in service ten exhaust steam injectors on four railroads. There are, however, as indicated in this report, 42 exhaust steam injectors on order distributed among six different railroads, as indicated in the table.

It is reported that one road has removed the one injector it had in service.

The information received from these roads is very limited, as some of these exhaust steam injectors have only been in service a short time. Two of the roads indicate that they expect to make

Railroad	In service	On order	Total
N. Y. C. & St. L.	1	30	31
N. Y. O. & W.	6	5	11
Bing. & Garfield	0	1	1
N. Y. C.	1	0	1
B. & O.	2	0	2
A. C. & Y.	0	1	1
N. P.	0	4	4
S. P.	0	1	1

extensive tests to compare the exhaust steam injectors with the standard injector in a short time. Until such time as these test reports are available, the only report the committee can make is a progress report.

Crosshead Connection of Piston Rods

In order to make a thorough investigation and determine the type of crosshead connection of piston rod in general use, a questionnaire was sent out. Replies were received from 93 roads, representing an ownership of 52,283 locomotives. Seventy-five of the roads reporting advise that they use the key only as a crosshead connection to the piston rod—18 roads that they are using both types of connection, viz., some power equipped with key, and some with the nut. None of the roads reporting, however, use the nut exclusively as a crosshead connection to piston rod.

Sixty-one of the roads using the key connection state that they consider the use of a key as a crosshead connection to the piston rod preferable, and their reasons for so doing may be summarized as follows: More reliable, saving of weight, readily applied, easier to maintain, more secure, less trouble in enginehouse maintenance, firmer hold, more accessible, simpler, less parts, easier to remove, nut cannot be properly tightened, difficult to fit and keep nut tight, permits smaller crosshead and shorter guides, no trouble of key becoming loose, cheaper to repair, key will shear in case of water in cylinder, thereby saving cylinder head.

Seventeen of the roads which use both key or nut give as their reasons for using the nut, as follows: Easy to detect looseness and rarely breaks rod in crosshead, fractures develop in key slot, less liable to injure rod, rod is stronger with nut, keys shear, easier to turn piston head to equalize wear.

One road recommends the use of nut on light power, with cylinders up to 26 in. and the key for heavy power.

A summary of the tapers reported is as follows:

Taper of piston rod—crosshead fit: 48 use $\frac{3}{4}$ in. in 12 in., 27 use $\frac{1}{4}$ in. in 5 in., 10 use $\frac{1}{2}$ in. in 12 in., 4 use $\frac{5}{8}$ in. in 12 in., 1 uses $\frac{5}{16}$ in. in 13 in., 1 uses 1 in. in 12 in.

Taper of key: 48 use $\frac{1}{2}$ in. in 12 in., 17 use $\frac{3}{8}$ in. in 12 in., 11 use $\frac{3}{16}$ in. in 8 in., 5 use $\frac{3}{4}$ in. in 12 in., 3 use $\frac{1}{4}$ in. in 12 in., 2 use $\frac{1}{4}$ in. in 5 in., 2 use $\frac{5}{16}$ in. in 12 in., 1 uses $\frac{5}{8}$ in. in 8 in., 1 uses $\frac{5}{16}$ in. in 12 in.

The taper of the piston rod fit in the crosshead and the key seems to be largely governed by the manufacture of the locomotives.

A summary of the number of threads per inch for nuts shows eight as the most common, although six and ten also are frequently used.

Seventy report little or no trouble when the piston rod is secured to the crosshead with a taper fit and key. Twenty-three report some trouble, much of which has been overcome.

Little trouble with the taper and key design breaking in the crosshead fit was reported when properly fitted. Some reported trouble with nuts but reports varied greatly.

It is felt by the committee that it is more important to rely upon a perfectly fitted taper to hold the rod in place than to depend upon drawing shoulder on the rod tightly against the crosshead boss with the key, as in the latter case workmen are prone to neglect the proper taper fit.

We believe that it is advisable that a ground fit be made for the piston rod in the crosshead, that standard reamers and gages be used to insure that the taper in the crosshead and the taper on the rod are exactly the same, and it is important that the key be properly fitted and a slight side clearance be allowed between the key and sides of the slot; also that the taper of the slot and of the key are exactly the same in order that the key impinges as intended.

The piston rods on modern locomotives are subjected to severe

strains, which emphasizes the importance of careful designing, accurate machine work and the most careful assembling.

It is scarcely necessary to emphasize the importance of a large sweeping radius behind the collar for the purpose of dissipating the bending stresses well out into the body of the rod.

It is also believed the crosshead fit should, if possible, be made slightly larger in diameter than the body of the rod; in other words, if the crosshead fit of the rod is so designed and proportioned as to compel the bending stresses to distribute themselves over the body of the rod there is much less likelihood toward failure of the entire rod.

We also believe it is advisable that the keys be made of alloy steel, preferably heat treated, in order to develop the maximum shear values and prevent deformation.

The majority of replies strongly indicate that the key is the preferred method in making crosshead connection to piston rod—all 93 roads report using it exclusively, or on some of their equipment. Most of these roads report little or no trouble from the use of these keys.

In view of the above, your committee hereby recommends adoption of the taper rod and key connection to crosshead.

This report was signed by H. T. Bentley (chairman), C. & N. W.; F. H. Hardin, N. Y. C.; A. Kearney, N. & W.; H. C. Oviatt, N. Y.; N. H. & H.; H. A. Hoke, Penn.; C. B. Young, C. B. & Q.; C. F. Giles, L. & N. W.; I. Cantley, L. V.; C. E. Brooks, C. N.; G. H. Emerson, B. & O.; H. H. Lanning, A. T. & S. F.; A. H. Fetter, U. P.; W. Kells, A. C. L.; H. M. Curry, N. P., and George McCormick, S. P.

Discussion on Tractive Force Formula

Mr. Bentley (chairman): It is recommended that these formulas be tried out for one year and at the expiration of that time recommendations made to the A. R. A. that they either have been found justified or that changes should be made therein. It is desirable that the I. C. C. be a party to any formula that is adopted and therefore I would suggest that the committee be continued with the understanding that a check be made of the formulas presented and a request be made for a representative of the I. C. C. to sit with us and approve what is finally decided upon.

O. C. Cromwell (B. & O.): We should back up this formula with further investigation, particularly in regard to the 50 per cent cut off locomotive. Roads generally are satisfied with the old Mallet locomotive formula. It would be well to approve the action of the chairman of the committee.

W. F. Kiesel, Jr. (Penn. System): As stated in the report, a standard formula, even though only an approximation, is desirable. The proposed formulas are theoretically correct in form. The coefficients, therefore, are the only factors open for discussion.

The coefficient for the four-cylinder simple Mallet, with 90 per cent cut-off, of 1.7, is well established. The coefficient of 1.5 for the four-cylinder simple Mallet, having 50 per cent cut-off, has been found correct, when additional steam is supplied through the valve leakage ports, which remain open until the piston has reached 80 per cent of its stroke. Without additional steam through these auxiliary ports, or their equivalent, the coefficient should be reduced to 1.2.

It is apparent that the committee formula for the four-cylinder simple locomotive, with 90 per cent cut-off, is based on an efficiency factor of 90 per cent. Taking R as the ratio of stroke to cut-off, the calculation becomes

$$\frac{.90 \times 4}{R + 1} = \frac{.90 \times 4}{\frac{1.00}{.90} + 1} = 1.7$$

Correspondingly, for 50 per cent cut-off, we have

$$\frac{.90 \times 4}{\frac{1.00}{.50} + 1} = 1.2$$

It is suggested that the committee eliminate the following: "While the steam which passes through the auxiliary ports has an effect on the mean effective pressure, it is believed that

the constant .75 may be used for any locomotive having approximately 50 per cent cut-off." and substitute:

"The constant .75 is recommended for all locomotives with approximately 50 per cent maximum cut-off, and with means for supplying auxiliary steam to a cut-off of at least 75 per cent. For locomotives with approximately 50 per cent maximum cut-off, and no means for supplying auxiliary steam, the coefficient .60 is recommended."

I suggest that because it is possible that a locomotive with approximately 50 per cent maximum cut-off and no means for supplying auxiliary steam will be built. In that case it will be necessary to change the coefficient.

The absence of a formula for a compound locomotive, when starting "simple," is commended.

Since the consideration of greatest importance is to have standard formulas reasonably close to actual results, as a basis of comparison between locomotives, the formulas should be adopted as the standard of the Association.

Mr. Bentley: I move that the formulas with the changes and modifications recommended by Mr. Kiesel be tried out and that definite recommendations may be made a year hence, taking into consideration that the Interstate Commerce Commission should be a party to this so that they will approve what is finally adopted.

Motion seconded and carried.

Discussion on Rods

H. H. Laning (A. T. & S. F.): One of these problems is lubrication—both the outer and inner areas. So far we have tried lubrication entirely from the outside. Another matter is controlling the lateral wear on the bushings. When we get all of these problems worked out floating bushings will be a complete success in both main and connecting rods.

A. H. Fetters (U. P.): The Union Pacific has gone into the subject of floating bushings quite extensively in the last three or four years. We began naturally on the middle side rod connection and our experience up to date indicates that the floating bushing will give 100 per cent more service than the single surface bushing.

There are two schools on the question of a wearing shell on the outside of the bushing. Some prefer an outside steel wearing shell as protection against the body of the rod, while others feel that they can get along without the extra shell. It is my belief that the simpler method is the best, and our experience indicates that the wear in the eye of the rod (if the bushing is permitted to turn in the rod) is such a minor matter that you can afford to put a little extra metal into the eye of the rod and turn the bushing in the rod. This has been our practice for the last two years. We experimented by putting a solid bushing on the back end of the main rod on one side of the locomotive and the usual split brass with key and strap connection on the other side. After that engine has been in service about seven or eight months the split brass has been down three times for repairs, and the solid connection has not been down once for anything. The total lost motion in the front and back where rotary bushings are used is 70 per cent less than for the split brass in the same engine.

For the rotary bushing on the main rod we are contemplating now replacing or making all replacement rods on our heavy power with solid back end as well as solid front end, getting away from all key connections. In doing that we will be able to save approximately 50 parts in one main rod—including straps, bolts, keys, washers, nuts, etc.

The material for the rotary bushing is of considerable importance. Something a little harder than brasses and bronzes can be used where only one surface rotates.

It is important to get almost as much surface on the outside of the brass as on the inside. That is to say, the width of the brass should be, if possible, nearly the full width of the brass on the pin, so that there will be little or no overhang on the outside rotating surface. That will help lubrication.

Another thing I think is going to be done in the rotary bushings is to put on two grease cups side by side on the same strap, with two grooves in the circular rotating parts, and two sets of holes so as to have more reserve, because more surface has to be lubricated than with one rotating surface.

W. C. Smith (Mo. Pac.): Some time ago, on one type of locomotive we had a lot of trouble with the middle connecting bushings getting loose. We changed from the pressed-in bushing to the floating bushing and found that we had no further trouble and the bushings ran as much as three times as long as the old bushings. That led us to try them out on back end main rods. On one passenger engine we placed a floating bushing on the back end of the main rod and a split brass on the other side, both in first-class condition. On that particular engine we renewed the split brass three times as compared to once for the floating bushing.

* We have had no trouble with lubricating the floating bushings. We recently purchased 50 locomotives (46 heavy freight types and four Mountain type) and put floating bushings in the middle connection, main connections and the back ends of all the main rods. We recently ordered 10 Pacifics and 40 heavy Mikados, all of which will be equipped with floating bushings in the middle connections and back ends of the main rods. In buying new rods or renewing rods we have decided to apply floating bushings in all back ends of main rods on the heavier power.

A. Kearney (N. & W.): My recollection is that the L. & N. used the floating bushing in the front end of the main rod, but not at the back end of the rod. On the Southern Pacific the floating bushing is used in the back end of the main rod but not in the front end. Why is that done?

Discussion on Extended Piston Rods

Mr. Fetters: Some roads like the extended piston rods. Others have used and abandoned them. On the testimony submitted it is scarcely possible for the committee to make a recommendation on this subject.

L. P. Michael (C. & N. W.): The report of the committee indicates a great diversity of opinion as to the benefits from the use of extended piston rods. There must be good reasons why some roads have obtained excellent results where others have found not only no special benefit but have obtained better service without it. Roads which have not had satisfactory service from this device have been unfortunate in that they have used a design of extended piston rod, shoe and guide which has not been suitable. A number of roads which had trouble with original applications have changed the designs and since obtained satisfactory service.

The report of the committee indicates that several roads, when they experienced trouble with this device, removed it. In many cases this must have been done without attempting to change the design to overcome the trouble.

To give satisfactory service it is necessary for the design of an extended piston rod and its details to meet the following requirements:

First. The diameter of the extension rod must be sufficient to support the weight of the piston without springing out of alignment. This is essential, for where the diameter of the rod has not been great enough to prevent springing, the extension rod has in many cases defeated the very purpose for which it was intended by throwing the extension piston rod packing out of alignment and causing both main and extension rod packings to leak and wear out rapidly.

Second. The shoe on the end of the extension rod must be of such design that it will be securely held in position, have ample bearing surface and have a suitable arrangement for lining up the rod to compensate for the wearing away of the bearing surfaces. The adjustment must be such that it can be easily made and also be positive and secure.

Third. A suitable positive method of lubrication must be provided for the extension guide and shoe. This lubrication should be continuous, the same as usually provided for main crosshead shoes and guides. The speed of the piston rod extension shoe on the guide is such that periodic oiling is not sufficient. Continuous lubrication is absolutely necessary for satisfactory service.

Fourth. A suitable cover should be provided for the extension rod shoe guide. This cover should be so constructed that it will keep out dust and dirt, be easily and quickly removable and be secure when replaced in position.

If the design and construction of an extended piston rod and its details are such that they meet the four above-outlined requirements, the life of the cylinder bushings, piston packing,

piston bull ring and piston rod packing will be greatly increased by the use of this device.

However, it is necessary to maintain the adjustment and alignment of the extension rod; otherwise, the device will not function properly. If the device is not properly maintained it should be removed, as the extension rod and shoe add considerably to the weight of the reciprocating parts, which is objectionable, as it makes the problem of counterbalancing more difficult.

When the extension piston rod is used the length of the main rod must be maintained even more carefully than is usually done. If the piston is permitted to strike the front cylinder head only slightly it almost invariably snaps off the piston rod extension guide close to the cylinder head.

Many enginehouse foremen do not favor the use of the extension piston rod simply for the reason that, with this device, it requires considerably more time to examine or replace cylinder piston packing. The fact should not be overlooked that even though the extension piston rod does cause more work and requires a longer time to examine and replace packing and also requires additional labor and expense to maintain the guide, guide shoe and extension rod packing, this additional labor and expense will maintain the alignment of the piston rod and piston in the proper position to give the longest possible service for the piston rod, piston rod packing, cylinder or piston packing, piston, cylinder bushing and main guides and crosshead shoes. The extra labor and expense required to equip and maintain extended piston rods on larger locomotives is fully warranted on account of the longer wearing and better service rendered. This has been the experience on the Chicago & North Western, which has had locomotives equipped with extended piston rods for more than 11 years.

The report indicates that there is a wide variation in opinion as to the minimum size piston on which this device should be used. Thirty-two roads believe there is no limitation as to the size, while 15 roads say that there is, and would apply them to cylinders over 19, 22, 23, 25, 27 and 28 in. in diameter, each of these figures being the size indicated by one or more roads. The limiting size of piston on which this should be used is an arbitrary figure, which should be decided upon by the individual roads, the governing features being the constructional design and service required of the locomotives.

The Chicago & North Western has used extended piston rods on several lots of Pacific locomotives with pistons 25 in. in diameter and having a 28-in. stroke, and on several lots of Consolidation locomotives with pistons 25 in. in diameter with a 32-in. stroke. The first lot of each type was built over 11 years ago. This road has also extended piston rods on all Mikado locomotives with 27-in. by 32-in. cylinders. It began to build this type of locomotive over 10 years ago.

The service obtained from these locomotives equipped with extended piston rods has been very satisfactory. However, this device is of greater benefit with larger and heavier pistons than with smaller and lighter ones. It is standard practice of this road at this time to use extended piston rods only on locomotives having pistons 27 in. in diameter or larger.

C. E. Chambers (C. R. R. of N. J.): About what per cent do you think the life of the piston packing ring will be increased by using the extended rod?

Mr. Michael: We have no definite figures but we are satisfied that it is considerable and the pistons wear longer. It not only helps the pistons but it keeps the crossheads in line because a great many roads have a tolerance for their pistons. For freight locomotives we allow a wear of 5/16 in. before they are renewed. This means some little movement and permits the guides to get out of line slightly. The extended piston rod helps that condition, in fact, overcomes it.

Mr. Bentley: Would you mind developing, Mr. Chairman, why they are taking them off on some roads and putting them on on others?

C. F. Giles (L. & N.): Our experience coincides with that of the Chicago & Northwestern. We received a large number of U. S. R. A. locomotives during and since federal control without the extended piston rods, and in nearly every case the master mechanics on the divisions where they were operated have asked for authority to apply the extended piston rods.

We applied extended piston rods to the Pacific type engine, which we began building in 1911, but did not apply them to the freight engines. Owing to the differences in wear, extended rods were soon applied to the freight engines as they came into the shops.

Mr. Kiesel: We have used a great many extended piston rods but I do not know whether we ought to keep them or not. I doubt whether there is any road in the United States today that has sufficiently high-grade maintenance to keep up extended piston rods. We may come to the point again when the maintenance is sufficiently good to use the extended piston rod and keep the pistons from riding on the cylinder bushings.

In checking up counterbalance one time I came to the conclusion that by the elimination of the cast-iron rims and making a solid steel facing, the extended piston rod is just about equivalent to the weight that you save by taking off the cast-iron rim; therefore it should make little or no difference in the reciprocating weights.

I agree with Mr. Giles that with high-grade maintenance, the extended piston rod is good and should be used, and if the maintenance is not sufficient to keep the piston off the bushings it is useless, and that is probably the reason why the committee could not make a recommendation because it all depends on the maintenance.

C. E. Brooks (Can. Nat.): I did not intend to say anything about our experience in Canada because on our railways there is just as much difference of opinion whether the extended piston rod should be used or discarded as there is in this country.

We have parts of the road where the extended piston rod is used and sometimes maintained. We have other parts of the road where the extended piston rod is used and frequently not maintained. On the greater part of the road the extended piston rod is not used. Where the extended piston rod is used and maintained it is a good device, but where it is used and not maintained it introduces much worse conditions than if it had never been applied. If there is anything to justify the use of an extended piston rod on large cylinders, the same reasons apply equally to the small cylinders. The maintenance of the extended piston rod where the water conditions are such as to necessitate frequent examinations of the packing ring is a difficult thing and we have found, particularly in those districts, that it is almost impossible to get good service, and for that reason I might say we have generally discarded it.

C. E. Chambers (C. R. R. of N. J.): Our road had four locomotives with extended piston rods; they were taken off and put into the shops and today there is no reason why they want them back again. As a matter of fact, the piston floats when it is working under steam and only drags when it is drifting. If there is a wide base on the piston head you can take care of the additional wear under those conditions. Without them you eliminate three opportunities for steam leakage on the front cylinder head, and that is worth a hundred times what they might save by the best maintenance.

C. F. Giles (L. & N.): Mr. Chambers has mentioned one feature of the operation of locomotives with or without extended piston rods, and that is the character of the railroad over which they are operated with respect to working under steam or drifting. On a level road where they work under steam constantly they have much less trouble with lubricating cylinders than on roads where they have to go uphill for a long distance and then drift for a long distance.

Discussion on Lubrication

F. H. Hardin (N. Y. C.): The efforts of the committee to produce data of definite value that might indicate the course to pursue in the consideration of hydrostatic versus force-feed lubrication of locomotives were not attended by any great degree of success as there seems to be little definite information available as to the relative value of the two systems. While some are strong advocates of force-feed lubrication, there are others who look upon this method of lubrication somewhat skeptically and it appears that it may be necessary to make some special investigation to establish something definite as to the relative merits of the two methods.

The committee has recommended an outline of tests which should be carried out on a number of railroads. It is suggested that these tests, at least in a general way, be conducted under the supervision of the committee and that the roads using or experimenting with force-feed lubrication be called upon, if interested to that extent, to co-operate by fitting up some of their locomotives and conducting a test.

C. E. Brooks (C. N. R.): Mention is made of a few roads

that have experimented, as we are experimenting, with the force-feed lubricator. There is no particular mention made of any troubles which have originated with this device. We are experimenting with one of the lubricators mentioned in the report, and we have yet to run into any trouble with this device.

Mr. Kearney: I think force-feed lubrication is very attractive but we have not been able to work it out. We had an engine equipped with the force-feed lubricator running between Richmond and Norfolk for quite a while, but we were unable to get any definite information as to the superiority of the device. At the same time, as I mentioned a moment ago, I am still of the opinion that there must be something in it.

Mr. Brooks: Might I ask what Mr. Lanning's experience has been on the ordinary rolling grades? Have you not been able to effect an economy in oil which we all expect from a force-feed? Have you not been able to get very much better lubrication with a force-feed lubricator than you ever got from a hydrostatic?

Mr. Lanning: In that case the results were satisfactory so long as weather conditions were good. We had a little trouble on account of priming in that particular location. I do not think we saved any oil. At least, I did not find that we did. We got along with about the same quantity, and it is my observation that the oil was not quite as well distributed over the wearing surfaces of the cylinder as it is with the hydrostatic lubricator.

Mr. Kearney: Our line between Richmond and Norfolk is in quite a level country; we did not get any increase in cylinder packing life where equipped with a force-feed lubricator.

Mr. Brooks: I can only give you our own results, which show an increase in mileage per pint of oil of approximately 30 per cent, and a very marked improvement in the condition of the cylinder walls, piston rods, and the life of packing rings, piston rod packing and everything which depends upon lubrication.

Mr. Kearney: How much more mileage are you getting out of your packing rings?

Mr. Brooks: We can't tell you definitely but we think it will run from 35 to 50 per cent more.

Mr. Kearney: That is a mighty big figure.

Mr. Brooks: Yes. That is a big figure.

Mr. Kearney: That is a good guess. We are getting about 22,000 miles from every set of four rings.

Mr. Brooks: That is not in high speed service, though. That would be in freight service. It would be very hard to get that in high speed service.

Mr. Kearney: I should say we get from 10,000 to 15,000 miles.

W. C. Smith (Mo. Pac.): I would like to ask Mr. Lanning what is the difference in the amount of oil consumed with a hydrostatic lubricator as compared with the force-feed lubricator? Have you any figures on that?

Mr. Lanning: I cannot give any definite figures, although we have them. I do not recall what they were. There was considerable increase in the oil consumed in the mountain territory. In the level territory the amount of oil used was about the same.

Discussion on Driving Wheel Lateral

B. H. Gray (Gulf, Mobile & Northern): Have any of the members had any experience with cast steel hub liners applied to driving wheels?

C. E. Chambers (C. R. R. of N. J.): We have used cast steel hub liners quite recently with very good success.

H. W. Codington (N. & W.): We have used sheet steel liners, working against bronze, and we have also used them in the reverse order. We have established in these tests that the rods and liners wear very much the same. If steel liners are to be used, why wouldn't it be just as well to finish the steel center without any liner at all—it would run a number of years against the bronze box hub,—and then introduce a sheet steel liner when it is found necessary?

G. S. Goodwin (C. R. I. & P.): We noticed that a number of engines that came with steel centers had no hub liners and we let the hub wear on the cast steel and we found it worked out very well. Our practice at that time was to apply cast iron hub liners, but we have changed that practice now.

C. H. Wiggins (B. & M.): We have used plate steel liners and cast iron liners and there seems to be no question about the material. The question is to keep it in place.

Discussion of Mechanical Stokers

A. Kearney (N. & W.): The committee is very much in earnest when it suggests that this subject now be turned over to the fuel committee.

If there is any difference in the consumption of coal between the different types of stokers, I have never been able to find it. We have, however, made quite a number of tests and have found better figures with one than another under certain conditions. Those same figures have been more or less reversed under other conditions, which in the end brings us back to the idea that there is not very much difference in the stoker itself, but we do believe that the most important thing we have before us is the selection of coal for the stoker. In some runs we made in the Allegheny mountains a few years ago we found that the stack losses ran up as high as 47 per cent. Very little more can be worked out of this stoker subject by this committee, but we should get something worth while if we turn now to the selection of fuel for the stoker, and it would be our earnest recommendation that this subject be turned over to the fuel committee. You can get good results if coal is properly prepared, so that the finely divided material has been removed.

B. H. Gray (Gulf, Mobile & Northern): Has this committee made any attempt to figure out what is the cost of maintenance of the stoker?

Mr. Kearney: A few years ago we compiled some figures and it was done very carefully. My recollection is that the cost ran around one dollar per 100 miles. The maintenance amounted to about one-tenth of the cost of maintenance of the locomotive. At one dollar per 100 miles in those days, it will now run, say, five dollars per 100 miles.

M. H. Haig (A. T. & S. F.): Stokers have been firing locomotives pretty successfully, but it is only natural to anticipate still further improvements. Most of the stokers now in the locomotive service have been confined to rather limited space. Manufacturers should design the parts, or the whole stoker for that matter, to make them readily accessible for inspection and for repair.

A stoker will ordinarily run at least two years or perhaps three years with a limited amount of repairs. However, after that time various parts fail. If those parts were so accessible that they could be inspected and repaired readily, it would reduce the number of engine failures.

Because of the limited space in which the stokers are applied, certain parts are covered by pipes and other parts of the locomotive, and the locomotive designer should consider those details in the very first layout of the locomotive and arrange so that the stoker can be repaired without going to a large expense in taking down the parts around it or taking down large parts of the stoker itself.

Mr. Kearney: The manufacturers have been doing a great deal towards reducing the cost of maintenance just exactly as Mr. Haig has said, and I think they would be only too glad to get any suggestions from anyone. We have all the stokers made, except the Elvin. There is very keen competition between the stoker manufacturers and they are after us daily to make changes to increase the stability of the machines, very often faster than we can make the changes.

H. C. Oviatt (N. Y., N. H. & H.): What difference does it make how much fuel economy there is in the stoker; what it costs to lubricate; what it costs to maintain it? There is not a man in the room who would put a stoker on a locomotive unless he was obliged to. We put stokers on because it is a necessity.

It would be unwise and unfair for the committee even to suggest the best type of stoker. Any suggestions of that kind might destroy competition. But it is the duty of the men who come here to listen to these papers to point out the difficulties they are having with each individual stoker and give the committee an opportunity to take them up with the manufacturers and see if they can remedy the trouble.

C. F. Giles (L. & N.): Stokers are now boiled down to four different types. It would be an easy matter for anybody interested to find out for himself, based on the experience that the railroads have had with these four different types of stokers, which stoker is the best to suit the conditions under which he wants to operate. I do not believe there will be any difficulty whatever in applying any one of these four stokers to any locomotive that has been built in the last few years.

Mr. Oviatt: There has been nothing said here about any individual stoker. All we have talked about is a stoker and this committee has not given us anything on the economy of maintenance or operation of any one of the four. Where is the fellow way back in the country who is building locomotives going to find that information? If he goes to any one of the four stoker companies they will tell him that they have got the best stoker. He has got to pick out the one that he feels is the most honest. When we come here we should not simply repeat what the committee sets out in its report. We ought to argue the various points in order properly to develop the subject. We should try to find the fellow that has had difficulty with his stokers and have him point out his experience to us.

Mr. Bentley: During the discussion of the locomotive stoker question the subcommittee made a recommendation that has not yet been acted on. I would like to have the matter brought before the convention in order that some action may be taken.

Chairman Coleman: In the discussion the suggestion was made that the report be turned over to the Fuel Committee. Do you desire that done?

Mr. Kearney: That is the request of the committee.

John Purcell (A. T. & S. F.): I make a motion to that effect. (*This motion was duly seconded, put and carried.*)

Discussion on Feed-Water Heaters

L. P. Michael (C. & N. W.) read the section of the report dealing with feed-water heaters and exhaust injectors and then said: A table has been compiled to show the number of heaters in service and on order, and the total for both the open type and the closed type. The list in this table only includes heaters which were reported by the railroads which replied to the questionnaire; therefore the report showing the number of heaters is not complete.

The replies to the questionnaire were such that the subcommittee felt it could not make any definite recommendations and wishes to submit this report simply as a progress report.

H. T. Bentley (C. & N. W.): I would like to ask the members whether they have had improved service from the closed type of heaters when placed ahead of the smokestack. I was wondering whether the location under the smokebox door would seriously affect the vision of the engineer, for a bridge, particularly, and also whether the location on the top of the smokebox would overcome some of the objections that we had to it when it was located down below.

H. C. Oviatt (N. Y., N. H. & H.): We were one of the first railroads to use the closed type of feed-water heater. We installed five of them to start with and the application carried with it an automatic valve. If that operates, all well and good. If it gets out of order you are likely to have a freeze up. When we considered extending the application of the feed-water heater we sought a new location and decided to put it on top of the smoke arch ahead of the stack, and to satisfy ourselves that it did not obstruct the view of the engineer or the fireman we constructed a templet, and used it on a run over the road. We found that the location did not obstruct the vision of either the engineer or the fireman. Since that time, or subsequent to that first application, we have applied approximately 20 additional in the later location and had in mind the application of some 16 or 18. This location eliminates the automatic valve.

We ran all through this last winter without a freeze up that came to my attention, and it would have come to my attention if there had been any serious trouble, because we have been very particular to keep the cost of maintenance of the feed-water heater down as low as possible and I would have known it if there was anything that caused a great amount of difficulty.

We experienced some difficulty with the first installation of the feed-water heater. We expected that but the difficulties with the water pump and some other small details have been worked out to our satisfaction and we feel that we are getting results to justify the extension of the feed-water heater. The difficulties on the road by failures of the feed-water heater are negligible. We have had one or two very minor failures, otherwise nothing to speak of and we feel that the feed-water heater that we use is satisfactory for application on locomotives in either freight or passenger service.

C. E. Chambers (C. R. R. of N. J.): I will subscribe to what Mr. Oviatt has said. We have one located on the bumper, we have 15 located up by the headlight and have 16 coming that will be applied the same way.

E. E. Chapman (A. T. & S. F.): The growing demand for feed-water heaters is shown in that up to March 1 there was a total of approximately 1,000 feed-water heaters either in service or on order in America, and at the present time there are over 1,500, either applied or on order. This means that in about four months there has been an increase of approximately 50 per cent in orders for the application of feed-water heaters. The locomotives built between March 1, 1922, and May 1, 1923, showed that counting all locomotives built or on order in America one-third were to be equipped with feed-water heaters. If switch and industrial engines ordered in this time be eliminated there would be about 50 per cent of the road engines which are now being built or on order to be equipped with feed-water heaters.

The Santa Fe has had feed-water heaters in service under test for about three years, and has the definite policy of ordering new equipment with feed-water heaters. In the various investigations made the service and repair of these feed-water heaters have been closely observed, in which means of properly cleaning the feed-water heaters of the closed type were developed.

In following the feed-water heater locomotives on the long locomotive runs of over 600 miles, it has been found that these locomotives on the last 200 miles of the trip tend to foam more than locomotives not equipped with feed-water heaters. The probable causes of this were: First, the presence of oil in the water from the condensate, and, second, due to working the locomotive harder, thus evaporating more water. The amount of water used by the feed-water heater locomotives, counting the amount of condensate returned to the boiler, indicated that the locomotives having the feed-water heater were worked harder. Where there were only a few of the feed-water heater locomotives on the division the tendency of the enginemen due to the soft sound of the exhaust was to work them harder. The reduction of approximately 30 deg. F. in superheat would also require that an additional weight of steam be supplied to the cylinders.

The use of superheated steam in the steam engine of the water pumps would probably do away with considerable of the trouble which was encountered on this road while testing feed-water heaters which were operated by means of steam valves, as these valves would stick when the boiler foamed. The trouble which was encountered on the road with the open-type heater was that when the pump was stopped while the locomotive was working the water chamber heated up and caused the pump to lose water.

All this indicates that as the various roads are equipping the locomotives with feed-water heaters special attention should be given to keeping these locomotives on the same division so that the enginemen will work the various locomotives uniformly and in this way it is believed that greater economy would result more quickly from the use of feed-water heaters. With the advent of the feed-water heater system on the locomotives and the heating up of the water to an average of 210 deg. F. so that in bad water districts the carbonates are dropped, it would seem feasible to further develop the apparatus for the elimination of this and sulphate scale material from the water before entering the boilers and in this way to eliminate a fuel wasting condition in such districts. An apparatus of this kind has been developed on the Hungarian State Railway and should be taken into consideration while the railroads of this country are now changing the methods of introducing feed-water into the boilers.

Discussion on Exhaust Steam Injector

B. P. Flory (N. Y., O. & W.): The first exhaust steam injector on the N. Y., O. & W. was applied in November, 1921, to a Mogul type engine in milk train service. This engine has 21-in. by 28-in. cylinders and weighs 150,000 lb. on the drivers. It is superheated.

In December, 1921, a test was made of the exhaust injector in comparison with the live steam injector. The test was made between Middletown, N. Y., and Weehawken, N. J., a distance of 78 miles in each direction, the round trip being considered a complete trip.

The train handling milk cars varied from 14 to 19 cars in length. The same engineer and fireman were used throughout the test. The consumption of coal with the live steam injector averaged 4.10 lb. per car mile and with the exhaust injector 3.29 lb. per car mile, showing a saving of 19.75 per cent. As this test was made in the month of December the weather varied considerably. The temperature of the water going in the boiler averaged 198 deg. F. There was also a noticeable drop in back pressure in the cylinder when the exhaust injector was used.

As a result of the test four new Mountain type engines were equipped with one exhaust injector and have been in service a little over a year. There has been no opportunity to make a test on these engines but it has been noticed that when for any reason the exhaust injector is not used considerable more coal is required.

The maintenance of these injectors has been very small so far. There has been some little trouble experienced in the operation of the injectors as there are a number of levers to manipulate and it requires considerable attention from the engineman. The operating arrangement can no doubt be simplified.

Our opinion is that the exhaust injector will give nearly as much saving in fuel as a feed-water heater and that its first cost and maintenance will be less.

Discussion on Crosshead Connections

M. F. Cox (L. & N.): I think one of the most important things in the report is to have the fit just as perfect as it can be made; that is, the piston rod should touch at every point of its bearing in the crosshead.

Chairman Coleman: The secretary has a communication from W. O. Moody (I. C.).

W. O. Moody (I. C.): In preparing a discussion on this topic I feel that we should be privileged to consider what would be termed side lights on the general subject. As the committee has made definite recommendations in favor of the key connection, a general consideration also of this phase of the subject should be in order.

The questionnaire has brought out the fact that there is a wide divergence of opinion and practice in this country as to what is considered the most suitable taper on crosshead fits of piston rods and crosshead keys. For the piston rod ends it varies from $\frac{1}{2}$ in. to 1 in. in 12 in., while the key tapers vary from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. in 12 in. The determination of a correct taper for these two important details of construction is a matter of mathematical calculation and investigation and should also include a correct crosshead hub diameter for any given rod fit diameter. If the piston rod taper is too abrupt we lose the holding power due to the wedging action of the taper, while with a slight taper there is a tendency of the rod to draw into the crosshead, which does occur with water between the advancing piston and the front cylinder head, resulting in a partial loosening or shearing of the key. A slight taper has another disadvantage in that it draws the rod into the crosshead to a greater extent due to repeated removal of the rods for stated periods of inspection or repairs and when this slight taper is set it is more difficult to remove the rod than when fitted with a more abrupt taper.

A dummy or draw key device should preferably be employed to force the rod into the crosshead and when once set the standard key inserted. If the structural condition will permit the rod to be

forced into the crosshead by blows on the piston end, as is done on the shop floor on trial fits, there would be little or no damage to either rod end or key. It has been noticed that repeated applications of the rod with the regular key upsets the metal in the rod back of and in line with the keyway slot and this upset metal gives a false indication of rod tightness as the rod seats on the upset portion, which may spell disaster before the next removal for inspection. This condition may also result in a loose fit between the key and the forward end of the crosshead hub and occasionally results in rods breaking $\frac{1}{2}$ in. or more inside of the crosshead hub. New rods should be relieved slightly at this point, top and bottom, and should always be inspected for this upsetting before being applied and relieved with a file if necessary. For the best results the piston rods should be a ground fit in the crosshead and not be accepted until a fit indication is shown the full length of the taper. Also the piston rod should be of the best material obtainable and a key of high grade steel used as well. The key should be considered as a device for maintaining the rod in the crosshead fit and not an instrument to make this fit, as it causes too frequent damage to the key. In new rods it is also advisable to have the radius on the key edge correspond with that of the slot-in-rod so that the key will bottom and not wedge on the sides in an endeavor to bottom in the slot. The key should be of even thickness throughout its length with an easy fit at the sides in both rod and crosshead.

We could place ourselves in position to secure additional information by studying the designing stationary engineer's methods of using both nut and key, but occasionally varying these two methods to the extent of threading the rod into the crosshead fitted with a split hub and secured by clamping bolts. This arrangement makes adjustment for clearance easy and accurate, as well as removal of the rod.

Preferably regular assigned men should handle this work in either back shop or roundhouse to be selected not only for their mechanical ability, but as well for their ability to appreciate the importance of good mechanical fits and with a realization of their responsibilities in being assigned to this work.

The crosshead key should be located as close to the hub end of the crosshead as strength requirements will permit, which will bring the key slot in the greatest permissible diameter of the rod with resulting maximum net cross section.

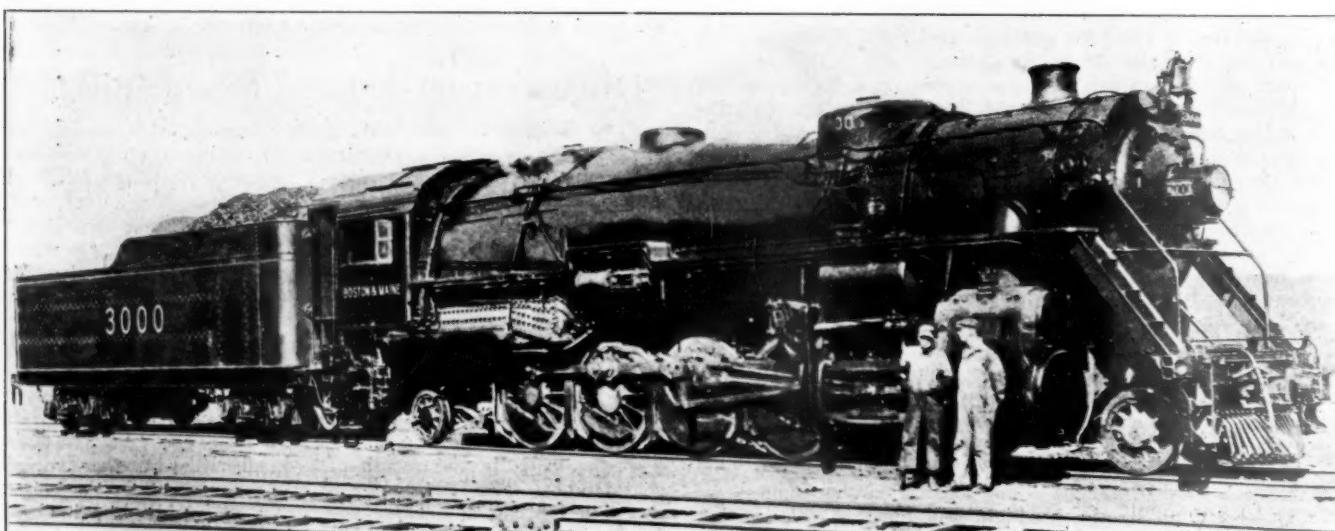
Failures may be induced by the crosshead design or by a lack of maintenance due to excessive play of crosshead in guides, resulting in a bending action piston rod.

The "Laird" type of crosshead, for example, has a tendency to produce strains in the rod near the crosshead hub unless the wear is kept within a safe pre-determined amount.

Chairman Coleman: A motion will be in order to have the report printed and sent out by letter ballot.

Mr. Purcell: I make that motion.

(The motion was duly seconded and carried.)



Increasing the Average Mileage of Locomotives

Mechanical and Transportation Department Co-operation Essential—Pooling Recommended

By C. F. Giles

Supt. of Mach. Louisville & Nashville

THE FACTOR "average locomotive mileage" is primarily one in which the mechanical officials of the railroads are chiefly concerned for the reason that it affords an accurate record of a character that fairly reflects, in a large degree, the measure of service that is being obtained from the motive power of a certain road as compared with some previous period or with that of other railroads. The locomotive may undoubtedly be considered as the fundamental unit of earning power of a going railroad and, therefore, representing as it does, such a large capital investment, it is obvious that a more intensive use of this equipment within practicable limits will admit of handling a larger volume of business with the same number of locomotives, which will be productive of increased returns in revenue and consequently, greater economy of operation, the ultimate goal sought. However, there are many elements that have a direct or indirect influence upon the matter of increasing the average mileage of locomotives, which I will briefly dwell upon.

The Pooling and Distribution of Power

Of most importance, especially in freight service, is the pooling of locomotives, that is, running them first in and first out, or in the order in which they can be gotten ready for service. The distribution of power should be under the absolute control of the chief mechanical officer, or his representative, who will be charged with the responsibility of supplying each division, or territory, with the power needed, or in transferring same from one division or territory to another where it can be used to the best advantage.

Daily Situation and Report

Showing Time in Enginehouse

To handle the matter successfully, he must keep himself fully informed as to the conditions existing on each division at all times. First, he should have a daily report to be furnished by the division officers, showing separately for each division the situation each morning; that is, the amount of tonnage ready to move and the number of locomotives available. He must also maintain a daily check as to the power situation at all engine terminals or turning points and have some means of knowing the time required to get engines ready by the mechanical forces, and also know if locomotives are being used promptly by the transportation department after they have been made ready for service. The form, suggested in Fig. 1, has proven of inestimable value for this purpose.

These forms should be prepared for each twenty-four-hour period by the mechanical officers in charge at each

engine terminal and forwarded promptly each day to the office of the chief mechanical officer, a copy also being furnished to the superintendent of the division. The chief mechanical officer, or his representative in charge of locomotive operation, will then be in full possession of all information as to the time required to handle each locomotive and may call for a further explanation where it is deemed necessary and in the interests of economical operation.

A consolidation of these reports is made daily in the office of the chief mechanical officer showing the following results (Fig. 2) for each division, and a copy is furnished to the chief officer in charge of operations and transportation.

Dispatchers Notified When Engines Will Be Ready

In addition to these reports it is necessary, in order to prevent unnecessary delay to power after an engine has been made ready for service, to have an arrangement in effect whereby the roundhouse foreman, or proper designated party, will keep the dispatcher, or other designated officer of the transportation department in charge of the calling and dispatching of trains, informed as to the probable time of day or night that locomotives will be ready for service. This information should be furnished the transportation department as soon as possible after the engine reaches the roundhouse. If considerable work is required and it is impossible to

make the estimate at the time of arrival, it should be done after the work of repairs has progressed sufficiently to enable him to determine about when it will be ready. A proper spirit of co-operation between the transportation and mechanical departments is essential as it has been found by actual experience that a very great reduction can be made in the time the engines are held in the enginehouse by the above arrangement. An occasional delay in getting a train out on call by reason of the engine not being ready at the time it was first estimated is more than offset by the time saved in getting engines and trains out faster and more readily than would be the case if they waited until all repairs were completed and the engine made ready in every respect before anything is said to the transportation department.

Responsibility for Utilization of Power

Where the distribution of power is under the supervision of the transportation department and the maintenance under the mechanical department, the latter have no special interest in the utilization of same after it has been prepared for service. Under the plan of holding the mechanical department equally responsible for its distribution, as well as its maintenance, should it develop that the transportation department is not



C. F. Giles

promptly using the power after having been prepared for service, the surplus power may be shifted to other points where it can be utilized to better advantage. This method of distributing power has a very material tendency to increase the average locomotive mileage and produces highly beneficial and efficient results in many other respects.

Advantages of Pooling Versus

Assigning Locomotives to Regular Crews

While the question as to the advisability of pooling locomotives and with respect to the opposite plan of assigning locomotives to certain engine crews appears to be divided, as both plans have their proponents and are in effect on a number of railroads, it stands to reason that a well organized pooling system in which the engines are delivered to service in the order as they can be first made ready, regardless of engine crews, thereby reducing the time engines are held at terminals, will unquestionably effect a more intensive use of the power and, consequently, reflect in increased locomotive mileage. It is recognized that locomotives, when assigned to regular crews may, to some extent, receive slightly better care while in their charge than when pooled, notwithstanding this fact the benefits from that source cannot be held to equal or offset the advantages had from the more intensive use and increased mileage under a properly organized pooling system. I have had experience with both plans on the same railroad for a number of years and unhesitatingly recommend the pooling plan as being the more economical and efficient from a general standpoint.

Prompt Handling at Enginehouses and Terminals

Any reduction of the period from the time a locomotive is detached from the train in the yard until it has been given the necessary attention in the enginehouse, made ready and attached to another train that is called to depart, should generally accrue to productive time and thus increase locomotive mileage. Therefore, it is obvious that the following operations should be handled with prompt dispatch, viz.: the movement between train yard and enginehouse, over the cinder pit and into the enginehouse for repairs, if necessary,

DAILY TIME REPORT OF FREIGHT LOCOMOTIVES HANDLED IN AND OUT

..(Name of Station).. ENGINE HOUSE....(Date)....1923

Loco.	Arrived		Departed		In Eng. House	Locomotive was Ready	Loco. held after being reported as ready for service	Remarks		
	Date	Time	AM or PM	Date	Time	AM or PM	Hrs.	Min.	Hrs.	Min.
	Total									

NOTE.—When delays occur on account of necessary work being done, full explanation must be made in Remarks column.

Fig. 1

otherwise over the repair or inspection pits outside of the roundhouse, the coaling, watering, sanding and providing the necessary engineer's tool equipment, oil cans and supplies, and the outward movement to the train yard sufficiently in advance of the time that the train is called, to admit of departure without delays. Inasmuch as the time devoted to extending repairs in the enginehouse usually consumes a large proportion of the total time that engines are held at terminals, the provision of adequate mechanical facilities at engine terminals, for promptly effecting necessary repairs, is a matter of vital importance. It is needless to state in detail the character of facilities that should be provided for this pur-

pose, as this has been a live and much discussed subject for the past few years, and all railroad officials undoubtedly realize what is needed in this respect at their various engine terminals.

Accounting for Mileage

That the chief mechanical officer and others interested in the subject may know to their personal satisfaction whether or not the results on their respective properties are good, bad or indifferent, it is suggested that they cause an investigation to be made to determine the following factors:

(1) Are your locomotives being credited with all the mileage actually made, including arbitrary switching miles, which, under the instructions contained in the I. C. C. classi-

STATEMENT SHOWING TIME OF FREIGHT LOCOMOTIVES IN ROUND-HOUSE, AND LEAVING DURING TWENTY-FOUR HOURS

ENDING MIDNIGHT.....1923

Divn.	Place	Total No. Locos. Turned	Minimum Time		Maximum Time		Total Time of all Locomotives		Time Held Ready for Total		After Service Average	
			Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.

Fig. 2

fication of accounting rules, are to be allowed at the rate of six miles per hour for the total time consumed in switching at line-of-road points?

(2) Compile a statement showing total miles made by individual locomotives each month in passenger and freight service, and after ascertaining the total average number of locomotives in service, less those in the shops for classified repairs; divide the total mileage by the number of locomotives in service and thus determine the average miles made by each locomotive. Comparison can then be made with the previous month, or previous year, and the matter followed up in this manner. Unless the officer in charge has this data, he is working in the dark.

Mr. Giles: (Continuing). I would not presume to say that many of the carriers are not using the same form that we are using for keeping a record of locomotive movements, but in order to make this paper complete I am going to file with the secretary a copy of the forms that we use for this purpose. If anybody cares to adopt them, they can be modified to suit the conditions that obtain on the individual railroads.

Discussion by J. N. Nicholson

Mr. Giles very elaborately covers the need for efficient handling of locomotives at terminals and its effect on locomotive mileage, also the advantage to be gained in pooling of power. These features have greatly increased the mileage per month, over that of the regular assigned locomotive. This is the foundation for the extended locomotive run over more than one operating division.

The extension of locomotive runs beyond the mileage made by one engine crew is being practiced on all main line through passenger trains between Newton, Kan., and Los Angeles, Cal., on the Santa Fe System. Four locomotives are used in handling each train over this territory, an average distance in each direction of 1606 miles, or an average of 401 miles per locomotive. A study of operating costs and conditions shows that it would not be practical at the present time to run passenger locomotives over more than one division between Chicago and Newton, Kan., first, because on the lines from Chicago to Kansas City, Mo., the terminal where most of the running repairs on locomotives are made is mid-way between these two points, at Shopton, Iowa, and on account of limited facilities at the Chicago terminal and congested conditions at the Kansas City terminal, it is not practical to run the passenger locomotives through Shopton. Second, because the division between Kansas City, Mo., and Newton, Kan., runs

through the mid-continent oil fields and it is cheaper to burn oil than coal on the passenger locomotives. The length of each passenger division on the territory between Chicago and Newton is: 234.6 miles Chicago to Shopton, Illinois Division; 216.5 miles Shopton to Kansas City, Missouri Division; and 195.7 miles Kansas City to Newton. The locomotives in this assignment are doubled frequently and the twelve month average mileage for all locomotives assigned to through passenger service on the Illinois and Missouri divisions is 6,039 per month.

Extended Passenger Runs

Extended locomotive runs are used on six passenger trains daily in each direction between Newton, Kan., and La Junta, Col., four of these trains being handled through to Los Angeles, Cal., with one additional train daily in each direction between Albuquerque, N. M., and Los Angeles, this latter train being routed over the Southern district, Newton to Albuquerque. The different trains vary from eight to fourteen cars. The scheduled average speed over different operating divisions varies from 24.9 to 46.5 miles an hour for different trains, depending on the grade and number of stops.

The territory over the Western and Arkansas River divisions between Newton, Kan., and La Junta, Col., is practically level or up grade westbound, the ruling grade being 0.8 per cent. westbound and short stretches of 0.6 per cent. eastbound. The distance by way of Great Bend is 369.6 miles, via St. John 355.3 miles, and trains are handled by the company's 1200 class Pacific type locomotives having 23½-in. by 28-in. cylinders, 79-in. driving wheels, and a tractive force of 33,300 lb. These locomotives are hand fired, coal burners. The engine crews change at Dodge City, Kan., which is 157.9 miles west of Newton. The roundhouse is convenient to the station at this point and the locomotive is cut off and taken to the roundhouse for coal, water, cleaning the pan, and filling the lubricator and grease cups. Water is taken at one intermediate point on each of these divisions and no fuel is taken enroute except in extreme weather or with heavy trains. The average monthly mileage was increased 15 per cent. by extending this locomotive run.

Heavy Grades on New Mexico Division

The territory over the three districts of the New Mexico division between La Junta, Col., and Albuquerque, N. M., passes over the Raton and Glorieta mountains. Helper locomotives are used on 175.3 and 184.8 feet per mile grades on each side of the Raton mountains and also on the 158.4 feet per mile grade eastbound on the Glorieta mountain. Exclusive of these helper grades, the ruling grade is 1.7 per cent. westbound and 1.4 per cent. eastbound, with numerous ten degree curves. The distance is 347.5 miles and trains are handled by the company's 3700 class Mountain type locomotives, having 28-in. by 28-in. cylinders, 69-in. driving wheels, and a tractive force of 54,100 lb. These locomotives are stoker fired, coal burners. Prior to extending this locomotive run, three crews and three locomotives were used and the present plan is to use three engine crews, changing at Raton and Las Vegas, N. M., enroute. The mileage for each crew between intermediate terminals is 104.6, 110.6 and 132.3 respectively. Trains of 13 and 14 cars are handled from La Junta to Trinidad, a distance of 81.8 miles, over a practically continuous 1.1 per cent grade without stop, at average scheduled speeds of from 31.6 to 40.9 miles an hour, using about 11,000 gal. of water. Fuel and water are taken at Trinidad and the ash pan dumped at the coal chute. Water is taken at Raton in both directions, lubricators and grease cups filled, and engine crews changed, without cutting the locomotive off the train. The next district is practically continuous 1.3 to 1.4 per cent. down or up grade to Las Vegas and most trains go through for coal and water. At Las Vegas the locomotives are taken to the roundhouse, being convenient to the station, and given coal and water, lubricator and grease cups are filled, ash pan dumped, and engine crews changed. The grade out of Las Vegas is practically continuous 1.7 per cent. to the top of the Glorieta mountain and down grade from Glorieta to Rosario, after which there are rolling grades of 0.5 per cent. to Albuquerque. The hours of scheduled locomotive service are practically the same in both directions and vary from 11 hr. to 14 hr. 35 min. with the different trains. The extending of passenger runs on this territory resulted in an increase of 45 per cent. in average monthly mileage.

The grades between Albuquerque, N. M., and Winslow, Ariz., are 0.6 per cent. in both directions from the top of the mountain at Gonzales, there being 97 miles of this continuous grade on the east

side of the mountain. Helper locomotives are used from Albuquerque to Dalies westbound over a one per cent. grade. The entire distance over this territory is 289.2 miles and trains are handled by the company's 1309 and 1327 class Pacific type locomotives, having 23½-in. by 28-in. cylinders, 73-in. driving wheels, and 39,650 lbs. tractive force. These locomotives are hand fired, coal burners, and take coal at Grants westbound and at Houck and Grants eastbound. Water is taken at each coal stop. All locomotives take water, dump ash pan, fill lubricator and grease cups, and change engine crews at Gallup, about mid-way.

Average Monthly Mileage Increased 29 Per Cent

Heavy mountain grades are again encountered over numerous broken mountain ranges between Winslow, Ariz., and Los Angeles, Cal. The altitude at the summit of the Arizona divide is 7,355 ft. above sea level, dropping down to 481 ft. at Needles, Cal. In passing over the Cajon summit of the California mountain range, an altitude of 3,820 ft. is reached, after which the grade descends to an elevation of 267 ft. at Los Angeles. Helper service is used eastbound on this territory as follows: On occasional heavy trains from Los Angeles to Pasadena, 114 ft. per mile grade, on all trains San Bernardino to the Cajon summit, 116.2 ft. per mile grade, and on heavy trains from Ash Fork to Supai, on 95 ft. per mile grade. The ruling grades where single engines are used are 1.6 per cent westbound and 1.8 per cent eastbound. There are numerous curves on this territory with a maximum main line curvature of 10 deg. The distance of locomotive runs on this territory is 606.4 miles via Pasadena and 617.1 miles via Fullerton eastbound. Tracks divide in places on this territory on account of grades, and the westbound track is 3.2 miles shorter than the eastbound. Four crews are used over four passenger divisions and the locomotive is not cut off the train in the entire distance. The company's 3700 class Mountain type locomotives are used, having 28-in. by 28-in. cylinders, 69-in. driving wheels, and 54,100-lb. tractive force. These locomotives burn fuel oil and take a supply at Hackberry and Bagdad enroute in both directions. Water is taken at Flagstaff, Ash Fork, Hackberry, Needles, Bagdad, Victorville and San Bernardino enroute. From 10,000 to 11,000 gal. of water are used between these water stops which is made possible by use of 12,000-gal. tenders on this class of locomotives. The scheduled running time westbound varies from 19 hr., 8 min. to 25 hr., 35 min. eastbound from 19 hr., 20 min. to 24 hr. 20 min. Extending locomotive runs on this territory increased the average mileage per month 29 per cent.

Mileage Increased 53 Per Cent

A passenger locomotive run of 490.6 miles is made from Phoenix, Ariz., to Los Angeles, Cal., consisting of one train in each direction each day. This run joins the main line at Cadiz, Cal., crossing the Cajon mountains described above. The scheduled running time in each direction is 15 hr. The ruling grades are 1.6 per cent in each direction with the exceptions of the 114 ft. per mile grade Los Angeles to Pasadena and the 116.2 ft. per mile grade San Bernardino to Cajon summit, previously mentioned. The locomotives used are the company's 1270 class Pacific type, having 23½-in. by 28-in. cylinders, 73-in. driving wheels, 37,800-lb. tractive force, and burn fuel oil. Prior to extending this locomotive run, three locomotives and three engine crews were used, and since extending the run, three crews are used with one locomotive, the average monthly mileage per locomotive assigned being increased 53 per cent.

Three passenger trains daily in each direction are handled between Kansas City, Mo., and Tulsa, Okla., a distance of 256.1 miles with one locomotive each. The crews are changed at Chanute, Kan., a distance of 126.2 miles from Kansas City. The locomotives used are the company's 1400 class, Atlantic type, balanced compounds, having 15-in. and 25-in. by 26-in. cylinders, 79-in. driving wheels, a tractive force of 22,200 lb., and burn fuel oil.

[Mr. Nicholson also gives full details regarding several other long locomotive runs on the Santa Fe. In general the average monthly mileage as shown in these cases has increased from 18 to 29 per cent.—EDITOR.]

The coal used between Chicago and Kansas City is from the Illinois and Missouri fields and is classed as high moisture, high ash, clinkering coal, running from 9,500 to 10,260 B.t.u. per lb. as fired. The Colorado coal is used between Newton and Albuquerque and between Clovis and Belen. This coal is a high ash, non-clinkering coal of a low moisture content, running about 11,700 B.t.u. per lb. The Gallup, New Mexico, coal is used between

Albuquerque and Winslow, it being a non-clinkering, high ash, semi-bituminous coal, running about 11,000 B.t.u. per lb.

Limiting Factor in Long Runs

of Coal-Fired Locomotives

The limiting factor in how far locomotives can be run most economically on coal burning divisions, is the condition of the fire. This is influenced by the quality and nature of the coal furnished as well as the skill with which the locomotive is handled and fired. It is believed that there are possibilities of greatly reducing the removable impurities and ash in fuel which will have an important bearing on the condition of fires. Coals having a high content of clinkering ash are not adaptable for long locomotive runs, on account of having to clean the fire by removing clinkers from the firebox. The high ash, non-clinkering coals require frequent dumping of ash pans enroute, which in most cases can be done while taking coal and water, or waiting for orders. The skilled fireman has a tendency to neglect his fire on the last part of the trip as he approaches the final terminal. If banks are allowed to form or the fire allowed to get heavy, there is a loss due to incomplete combustion before reaching the terminal, in addition to the loss due to this unburned coal being dumped into the cinder pit. If it is once established that fires are to be run over the next operating division, the incoming fireman will take better care of his fire and use less coal as a result.

The carrying capacity of the ash pan limits the amount of dead ash that can be shaken through the grates. This capacity in many cases is not large enough to carry the accumulation from high ash, non-clinkering coal over more than one division. The importance of this feature in connection with extending locomotive runs is worthy of serious consideration in the use of ash pan hoppers on the outside of the frame where the trailer design will permit. Also, if the coal is the best that can be furnished and is skillfully used, it is possible that the fire can be kept in good condition for a longer period of time by a better designed grate.

With Oil Burning Locomotives

Boiler and Machinery Conditions Limit Runs

The fuel oil used is all put through a process of distillation to remove the lighter, high volatile oils. California fuel oil is used on the Pacific coast from Winslow, Ariz., west. Mid-Continent fuel oil is used from Kansas City to Newton in passenger service and from Newton south to Purcell and west to Clovis in all classes of service. Mexican fuel oil is used from Purcell to Galveston.

The limiting factor in how far an oil burning locomotive can be run most economically is governed by boiler water conditions or machinery conditions rather than the condition of the fire. In Arizona and California, the untreated water on the desert has from 5.5 to 37.9 grains of incrustants in solution and from 9.7 to 63.0 grains of solids in solution, and requires heavy treatment. The treated water contains from 2 to 7 grains of incrustants in solution, and when boilers are washed frequently, they do not scale excessively. The solids in solution are reduced by treatment but it is necessary to wash boilers at the end of each trip over four operating divisions to reduce the concentration of foaming impurities. On this run, from 75,000 to 80,000 gal. of water are used by Mountain type locomotives on passenger runs of from 24 to 25 hr. service. It is necessary to blow out systematically and frequently to keep down the concentration of foaming impurities in the boiler. Where treated water is used, little or no trouble is experienced from the mixing of different waters on the desert territory.

The most severe strains which are set up in a boiler are brought about by expansion and contraction due to heating and cooling that takes place during the process of knocking fires and re-building them. Each time this process is eliminated will increase the life of a boiler, besides save from 2,000 to 4,000 lb. of coal for each terminal that the locomotive is run through.

Increased Lubricator Capacity Needed

In most cases a sufficient force is maintained at intermediate terminals to meet locomotives and fill lubricators and grease cups. The practice of having men meet locomotives to give this service is costly considering the amount of service rendered, and it is believed that a design of increased lubrication capacity can be worked out that will reduce the need for this service at intermediate terminals to such an extent that it can be handled by car inspectors and enginemen. The use of floating bushings has been found to greatly reduce the trouble with hot pins.

Long Runs Not Primarily

Responsible for Hot Bearings

The bearings on a locomotive heat up gradually in service until a uniform working temperature is reached. If the bearing is properly proportioned and adequate lubrication is maintained, this working temperature will remain about constant. A check of the hot bearing failures experienced in four months on the Winslow to Los Angeles run of 20 to 25 hr. continuous service shows that 30 per cent of the hot bearings occur on the first operating division out of the terminal, 65 per cent on the two districts of the Arizona division, and 5 per cent of the total cases occur on the last division before completing the run. The two districts of the Arizona division comprise about 52 per cent of the total mileage, making the percentage of total failures per mile about the same as on the first division out of the terminal. This shows that other causes are responsible for more hot bearing trouble on these locomotives than the length of locomotive runs. If the bearings continue to run hotter at the end of four to six hours out of the terminal, it may be that the run over one operating division is the limit for this class of power. The extended locomotive run will require liberal bearing proportions that are as low in weight per unit of area as conditions will permit.

The road-side facilities in the way of coal chutes and water cranes have been located with the idea in mind that the locomotive will always be furnished with a full tank of coal and water at the terminal. Where no main line coal chute and water crane are provided, this will require an additional stop for coal and in some cases another stop for water, and in some cases will require additional stops on the next operating division. The facilities will have to be developed along lines to meet the needs of extended locomotive runs. In most cases there is apparent need for main line water cranes at the depots at terminals where passenger locomotives are run through. New coal chute locations should be carefully studied with the idea of being able to serve locomotives on the main line as well as at the terminal.

Maintenance Work at One Terminal

It has been the practice for many years to do practically all of the work on a locomotive for the round trip at one terminal and to provide modern facilities for doing work at this terminal. It would cause an increase in repair costs to run locomotives by such a terminal and attempt to maintain the locomotives at a much less efficient terminal. Under these conditions, it is desirable to reduce the layover at the minor terminal to a minimum and make the layover at the principal terminal as great as conditions permit. The issue of prime importance is the highest mileage per day per locomotive with the least expense for repairs with the existing facilities.

Reductions in Repair Costs

The reduction in repair costs varies with different divisions, depending on how much the work is reduced at intermediate terminals by running either the freight or passenger locomotives through. In most cases a slight increase in forces has been found necessary at terminals handling the repair work on locomotives where the runs have been extended. This increase varies from 15 to 47 per cent of the reduction made in forces at intermediate terminals. Changes in locomotive assignment, the increased business handled, the extension of runs on a certain percentage of locomotives handled at the different terminals, and other variable conditions make accurate comparisons on repair costs hard to obtain without exhaustive study. The comparisons available show a decrease of 12½ per cent in total man hours per locomotive turned between Chicago and Kansas City, where only the through freight locomotive runs have been extended. The passenger locomotives between Newton and La Junta, and between La Junta and Albuquerque, are maintained using 147 less men at intermediate terminals and 50 more men at points where repair work is being done. The locomotives on extended passenger runs between Winslow and Los Angeles are maintained using 81 less men at intermediate terminals and 38 more men at points where repair work is being done.

When an intermediate terminal is discontinued, the delayed time of locomotives that were handled at that point is transferred to the point where the locomotive is cut out and unless the assignment of locomotives is reduced or the volume of business increased, there will be a decided increase in locomotives at the end of the run awaiting trains or undergoing repairs. In running locomotives through intermediate terminals, the assignment should be cut a per-

centage of approximately as much as the intermediate delay reduces the total time per round trip, or congestion of power will occur. If the locomotives depart from the terminal in fleets, there will be a larger assignment needed than where they are scheduled to leave at more regular intervals.

Effect of Variation in Grades

The variation in grades of adjoining operating divisions on the Santa Fe is from 0.6 to 3.5 per cent, which, to some extent, limits the extension of locomotive runs. Divisions of this kind require an assignment of different types of power fitted for the work they are to perform. Mountain type passenger locomotives or the low wheeled Santa Fe type locomotives could not be operated economically over a prairie country nor could the high driving wheeled passenger or freight locomotives be operated economically on a mountain grade.

The Santa Fe is not classed as a road making long locomotive runs as far as mileage is concerned, but mileage alone is not an index of performance that will give the roads operating over mountain grades credit for what they are doing. The scheduled hours of continuous passenger locomotive service and the continuous hours of scheduled through freight locomotive service seems the only basis of comparison that is fair to the roads encountering mountain grades.

Long Runs Not Practical on All Divisions

There are divisions and terminals where the extension of locomotive runs is not practical with the present facilities. However, the extended locomotive run is making marked progress and it has been demonstrated that the increase in locomotive mileage is equal to or greater than the increased mileage due to the general pooling of power over the regular assigned engines. The pooled locomotive and the extended run have doubled the mileage of locomotives on many territories over the regular assigned locomotives. The reduction in forces at intermediate terminals is the largest item contributing to reduction of cost of repairs to locomotives per unit of service. The economies due to making the extensive repairs at a terminal having a high standard of terminal facilities will make possible a high standard of labor efficiency. This, in addition to reducing the amount of work at less efficient terminals, will tend to reduce repair costs. The increased mileage per month gives a larger return from the capital invested in locomotives. The heat stored in a boiler when arriving at a terminal is equal to the heat which can be abstracted from a ton of coal or its equivalent in fuel oil, and this is wasted if the boiler is allowed to get cold. This fuel, and the fuel used holding the boiler under steam waiting for a train, are saved. With these economies in view, the development of facilities to extend locomotive runs more efficiently will follow.

By O. S. Jackson

S. M. P. & M., Union Pacific

Previous to 1921 passenger trains between Council Bluffs, Ia., and Cheyenne, Wyo., 509 miles, changed locomotives at Grand Island, Neb., North Platte and Sidney, Colo., making four engine divisions. In March, 1921, Sidney was cut out, resulting in runs from North Platte to Cheyenne of 225 miles. Results were such that a year later Grand Island was cut out, resulting in a run of 284 miles from Council Bluffs to North Platte—later North Platte was cut out, resulting in a 509-mile run from Council Bluffs to Cheyenne.

The long locomotive run in passenger service is now established practice on the Union Pacific and regular scheduled passenger trains are operating as follows without changing locomotives:

Council Bluffs, Iowa, to Cheyenne, Wyo.....	509 miles
Council Bluffs, Iowa, to Denver, Col.....	562 miles
Cheyenne, Wyo., to Ogden, Utah	483 miles
Denver, Col., to Ogden, Utah	577 miles
Kansas City, Kans., to Ellis, Kans.....	303 miles
Ellis, Kans., to Denver, Col.....	337 miles

The Council Bluffs-Cheyenne, Council Bluffs-Denver, and Ellis-Denver runs are operated with Pacific type locomotives developing 38,600 lb. tractive effort, hauling trains having from 10 to 12 all-steel cars, with schedules, including stops, ranging from 32 to 44.9 miles per hour.

The Cheyenne-Ogden run, 483 miles, and Denver-Ogden run, 577 miles are operated with Mountain type locomotives, having a tractive power of 54,838 lb. These engines, which were delivered

last winter were particularly designed to withstand the long runs over the mountain territory, where a maximum grade of 1.55 per cent obtains for 30 miles, in addition to hundreds of miles of undulating grade of .82 per cent.

In freight service the following locomotive runs are established in regular service:

Omaha, Nebr., to North Platte, Nebr.	284 miles
North Platte, Nebr., to Cheyenne, Wyo.....	225 miles
North Platte, Nebr., to Denver, Col.....	278 miles
Kansas City, Kans., to Ellis, Kans.	303 miles
Ellis, Kans., to Denver, Col.....	337 miles

We have had the same success in operating locomotives over these long freight runs as in passenger service, and the result has been to reduce the number of freight engines required to handle a given volume of business by approximately 20 per cent.

Training of Personnel Important

We do not feel that the accomplishment of these long runs was a particularly difficult problem, although there were certain factors that required careful attention, particularly the training of all personnel in assuming the new and different duties introduced. We realized from the start the successful operation of coal-burning locomotives in regular passenger service on long runs was contingent on the motive power being in good condition, and on the co-operation of enginemen. While some honest reluctance was naturally encountered in introducing so abrupt a change from the routine to which enginemen were accustomed, this opposition was effectively overcome and our men are now entirely in accord with our policy.

The Union Pacific is fortunate in having admirably adapted fuel for this service. It is a non-clinkering, coking, high volatile coal with low ash content of the following average analysis—

Moisture	11.6 per cent
Volatile combustible	35.92 per cent
Fixed carbon	47.53 per cent
Ash	4.95 per cent
Sulphur	1.48 per cent
Heat value, B.t.u.	11,430

We found it necessary, however, to re-educate our firemen in the handling of their fires so as to bring a proper fire into intermediate terminals, until now it has become the conscientious duty for each fireman to turn over to the next man a fire in such condition as the original fireman would desire to start out with.

There is some saving in fuel by the fireman knowing he must turn over a fire in good condition. This, however, is an unknown quantity. The cleaning of fires while engine is on train is now a very rare occurrence.

Varying Boiler Waters Present a Problem

The harmonizing of the action of the totally different kinds of boiler waters encountered in such a long territory is an additional problem, which our chemical experts have solved in a very satisfactory way. Two important details in this process are the judicious use of anti-scale boiler compound and anti-foam compound. The road-side water softening plants must also be operated with special reference to variation in water supply. Our boiler maintenance due to water troubles, if anything, is less than under former operating conditions.

So far as boiler deterioration and maintenance is concerned, it is evidently an advantage to take the mileage out of a locomotive with a minimum number of times a locomotive is fired up and cooled off, therefore, the long run cannot help but produce a flattening saving in boiler work estimated on the mileage basis.

The principal advantage of longer locomotive runs is the saving in the number of locomotives required to produce a given number of train miles. Another obvious advantage is the saving effected by keeping the locomotive out of intermediate terminals through saving effected in enginehouse expense, running repairs and fuel. We estimate a saving of one ton of fuel for each intermediate terminal passed.

This arrangement of locomotive runs has relieved already congested terminals where additional roundhouse stalls and other facilities would have been necessary in a short time.

Locomotives on our long runs are in continuous service from a minimum of 11 hours to maximum of 16 hours, and the average layover is now about 15 hours after each trip. We expect to reduce the average layover to 12 hours or less, having preferred to be liberal while inaugurating the system. Layovers of less than

eight hours after so long a period in service would not be practical except for a few trips at a time.

At approximately mid-points on the long runs, as at North Platte and Green River, lubricators are filled both east and westbound.

These long runs have developed the desirability for a lubricator of sufficient capacity to carry oil for a 700-mile division.

One relief engine is placed at a midway terminal, which can be prepared for service on short notice. This engine protects from 20 to 22 passenger trains per day. We originally started with relief engines at three terminal points, but the reliability of the service justified cutting out all but one. Trains are held at intermediate terminals from five to ten minutes, and at terminals where shop or roundhouse is close to the depot we have a machinist and helper meet all trains. The machinist looks the engines over and makes any light repairs they need or can be made, while the helper fills or screws down grease cups.

Terminal Repair Facilities Concentrated

One of the possibilities of the long locomotive runs is that of concentrating on more adequate improvement at a few important terminals, instead of spreading out the appropriation to cover additional stalls, machine tools, ash pit facilities, etc., at a lot of poorly equipped intermediate terminals. The concentration of improvements at the more important points will bring a bigger return on the investment by making possible a higher degree of labor

efficiency at these points.

It is, of course, necessary that after an engine runs 500 miles or more it will require a closer inspection and more work than after it has completed a 150-mile run, but the length of layovers on the long runs has been adjusted so that the extra inspection and work will carry the locomotive through the long run without increasing the chance for engine failure, and our records show that we are now making greater engine mileage per failure than formerly.

Other Discussion

E. F. Allard (C. & N. W.): Mr. Nicholson called attention to the effect on fireboxes of the less frequent knocking of fires. Is there any record as to just what saving there has been?

Mr. Nicholson: I am not able to give any figures on that.

Mr. Allard: How frequently do you find general shopings with the long runs as compared with the previous practice?

Mr. Nicholson: Less, if anything.

Mr. Jackson: The Union Pacific is not trying to get big mileage between general shoping. To keep our locomotives in condition to start out on these long runs we have got to take our locomotives in more carefully. However, we figure that when we do take them in it is less expensive.

Mr. Brazier: I move that a vote of thanks be extended to Mr. Giles for his very able paper on increasing locomotive mileage.

(The motion was seconded and carried.)

Message from Sir Henry Thornton

[Sir Henry Thornton, president of the Canadian National Railways was scheduled to address the meeting on Friday. He was unable to attend the meeting, however, but sent a message. Chairman Coleman before reading this message said: I have another message from a man who is a protege of one of the biggest railways in this country. He left this country a number of years ago to accept a position in Europe. He has since returned to Canada to take charge of what I suppose is one of the largest railways, due to consolidation, in the world.]

IT WAS with keen regret that, owing to engagements already made in Western Canada, I was obliged to advise the president of the American Railway Association, Mr. Aishton, that it would not be possible for me to attend the annual meeting of the Mechanical Division of the Association.

As a member of the board of directors of the American Railway Association, I would request you, as chairman of the Mechanical Division, to convey my greetings to the members of that division assembled for their annual meeting, and my best wishes for the success of their discussions and deliberations.

Had I been present personally, I would have said to the members that the board of directors of the American Railway Association, and in fact all of those charged with the administration of railways in the United States and Canada, are looking to them for help not only in maintaining that high degree of service which the roads generally have always given the public, but in improving the service still further.

The public is probably unaware of the good work which is being performed, unostentatiously but effectively, by such bodies as yours. The spirit of co-operation and teamwork which exists in your division, whose members are drawn from many railways with diverse interests and varying conditions, is gratifying and commendable. Very many of the important improvements and economies in transportation

service have been due to your efforts and your untiring zeal in the study of mechanical problems and their suggested solution. In these days when transportation costs are to a considerable extent beyond the control of the managements themselves, the work you are doing, having, as it does, for one of its main objects the development of more economical



Sir Henry W. Thornton, K.B.E.

operating methods, is particularly important; and I am sure, in voicing my personal appreciation of your efforts, I am speaking for the executives as a whole. I would like to leave this thought with you: That we are looking to you to help us give the public of the United States and Canada a transportation service which cannot be excelled anywhere in the world.

Report on Electric Rolling Stock

The Committee Proposes General Specifications for Periodical Inspection and Maintenance

THE committee submits the accompanying rules for the maintenance of electrical equipment, both locomotives and cars, in such general terms that rules covering local conditions can be added to them, and recommends consideration of these rules as the recommended practice of the Mechanical Division of the American Railway Association.

Instructions for Maintenance of Electrical Equipment of Rolling Stock

These instructions are based, in general, on the experience and actual practice of those roads having electrically equipped rolling stock. They are offered as suggested practice for other roads having equipment of this character. It should be understood, however, that the requirements are not binding and may be modified in any respect to suit the local conditions on the roads adopting them. Inasmuch as these instructions necessitate the performance of work on electrical apparatus and circuits, attention is called to the fact that such additional instructions, as may be necessary, must be issued to insure that the work is performed in such a manner as to avoid personal injury to the workmen.

1. Such parts of these instructions as are applicable to any class of equipment, shall be considered to apply to that class of equipment.

2. The periods of regular inspection shall be as follows:

(a) *Locomotives*—Every 2,500 miles, or such other mileage as may be considered suitable.

(b) *Multiple Unit Cars*—Every 1,500 miles, or such other mileage as may be considered suitable.

3. The periods of heavy inspection shall be as follows:

(a) *Locomotives*—Every 10 regular inspections.

(b) *Multiple Unit Cars*—Every 10 regular inspections.

4. The periods of class repairs shall be as follows:

(a) *Locomotives*—Every 150,000 miles.

(b) *Multiple Unit Cars*—Every 100,000 miles.

5. At regular inspections the following work shall be performed:

Main Motors—(a) Inspect motors for mechanical and electrical condition. (b) Gage with feelers the mechanical clearance between armature and pole faces to determine wear of armature bearings; also check lateral movement of armature. (c) Clean commutator and string band. (d) Inspect brushes and brush shunts to determine that brushes are properly seated on the commutator and fit the brush holder, that the brushes do not have copper embedded in the contact face, that the shunt connections are tight and shunts are not broken. Repair defects or renew brushes or shunts. (e) Lubricate armature and axle bearings. (f) Examine air connections and repair defects. (g) Inspect motor nose suspension, gears and pinions, and repair if necessary. (h) Blow out all dirt with dry compressed air. (i) Test insulation resistance with 35,000-ohm magneto, or 1,000 volts to ground for one minute, for short circuits and grounds.

Main Motor Wiring, Including Bus Jumpers—(a) Inspect motor circuit wiring and conduit for mechanical defects and defective insulation. See that all connections are tight. Repair all defects found. (b) Test all motor circuit wiring and connected apparatus, such as rheostats, circuit breaker, switches, etc., with 35,000-ohm magneto, or 1,000 volts to ground for one minute, for short circuits and grounds. Repair all defects found.

Rheostats—(a) Inspect all rheostats for broken grids and loose connections. Repair all defects found. Test rheostats with 1,000 volts for short circuits or grounds.

Circuit Breakers—(a) Clean circuit breaker and inspect contacts and connections. Clean insulators. Dress or renew defective contacts. Inspect supporting bolts and insulators. Test operation, including re-set and tripping device. (b) Where oil circuit breakers are mounted outside of car or locomotive, it will probably be necessary to change the grade of oil in winter and summer. This should be done at the nearest regular inspection.

Reverser—(a) Clean reverser and inspect contacts and connections. Dress or renew defective contacts. Clean insulators. (b) Inspect magnet valves and clean or adjust as needed. (c) Test to see that reverser operates properly.

Switch Group or Contactors—(a) Clean switches and if necessary renew or dress contacts. Examine arc chutes and repair or replace sides if necessary. Wipe off insulator. (b) See that all connections are tight. (c) Examine and clean interlock contacts, examine fingers for tension and adjust if necessary. (d) Inspect magnet valves and clean or adjust as needed. (e) Test to see that switches operate properly.

Transformer and Impedance Coils—(a) Examine connections for mechanical condition. See that connections are tight. Repair all defects. (b) Examine air connections and repair defects. (c) Blow out ducts with compressed air.

Pantographs and Connections—(a) Examine shoes and horns, replacing if necessary. (b) Examine hinges, tubing, links, etc., for wear or defects. (c) Examine shunts and connections for signs of heating or breakage. (d) Examine hoses for leakage or weakness. Wipe off insulators and see that they are in good condition. (e) Test operation. Gage height of low voltage pantographs. See that high voltage pantograph pressures are within required limits.

Trolley Pole and Parts—(a) Inspect trolley base, pole, harp and wheel. Straighten or renew bent or defective poles. Adjust contact tension between harp and wheel if needed. Renew defective wheels. (b) Inspect trolley rope and retriever. Renew rope and repair or renew retriever as needed. (c) See that all parts operate properly.

Third Rail Shoe Beams and Brackets—(a) Inspect third rail shoe beams and brackets for split or broken beams, and broken or loose bracket bolts. Tighten bracket bolts or renew defective parts.

Third Rail Shoe Leads—(a) Inspect third rail shoe leads, connections and conduit. Tighten connections and renew defective parts.

Third Rail Contact Shoes—(a) Inspect third rail contact shoes. Renew worn or broken shoes. (b) Gage third rail contact shoes to see that they are in proper position in both vertical and horizontal planes. Adjust to correct position if necessary. (c) During and immediately prior to cold weather, examine extra pressure devices and sleet scrapers, maintaining them in first class condition. (d) Examine, test, and gage automatic train stops, repairing any defects found.

Third Rail Shoe and Other Fuses—(a) Inspect fuses, fuse blocks and supports. See that proper number of fuses is in each box. Repair or renew if defective. (b) Test fuse clamp operation to see that it works freely.

Knife Switches and Grounding Switches—(a) Inspect to see that blade meets jaws squarely; that contact surfaces are smooth and make contact all over with proper pressure. (b) Inspect operating mechanism, if any, and see that it operates properly. (c) Inspect connections to see that they are secure and show no signs of heating.

Trolley Lightning Arrestor and Ground—(a) Inspect trolley lightning arrestor. Repair, renew or tighten as may be necessary.

Conduit Carrying 600-Volt Wiring Inside Car—(a) Inspect grounds and test with bank of lamps to make sure the conduit is properly grounded.

Main and Regenerative Control Circuits and Electrical Connections to Air Brake Apparatus, Including Jumpers—(a) Inspect control circuit, and electro-pneumatic brake circuit, wiring and conduit for mechanical defects. Repair or renew any parts found defective. (b) Test all control apparatus and electro-pneumatic brake apparatus with 35,000-ohm magneto, or 500 volts, for shorts and grounds. Repair all defects found. (c) Inspect all interlocks for worn or broken fingers and loose connections. (d) Try out sequence of switches and operation of electro-pneumatic brake; checking out for grounds with voltmeter at the same time.

Master Controller and Electro-Pneumatic Engineer's Brake Valve—(a) Remove covers and inspect for burned or broken fingers, rough drum, loose connections, etc. Operate controller to see that fingers have proper lift and clearance. Renew or repair as needed. (b) Test operation of control plug or cutout switch and push buttons. Repair or adjust if needed.

Edison Battery—(a) The electrolyte shall be adjusted to the proper level, using an Edison cell filler, by adding distilled water. (b) The voltage of the battery as a whole shall be read, the battery discharging for one minute at approximately normal rate. Individual cell readings shall also be taken. (c) Should the voltage of the battery as a whole average 1.2 volts per cell or

less, the battery shall be fully charged. If any cell is materially lower than the average, action shall be taken to overcome the trouble.

Lead Batteries—(a) Check the voltage and specific gravity of each cell. If the voltage of the battery as a whole is lower than normal, or if the individual voltage or specific gravity of any cell is lower than the average, determine the cause and rectify it. (b) Fill all cells with distilled water to proper level. If the level of electrolyte in any cell is found materially lower than that of the average, determine the cause and rectify it. (c) Keep the terminals and connections clean and cover with vaseline to prevent corrosion.

Circuit Breaker Re-set Switch—(a) Inspect circuit breaker reset switch. Dress or renew contacts if necessary. (b) Check operation of circuit breaker.

Relays—(a) Inspect and adjust if necessary, all relays, seeing that they function properly and are in good condition.

Comptroller Motor, Blower Motor and Motor Generator Set—(a) Inspect motors and motor generator set for electrical and mechanical condition. (b) Check bearing wear by use of feeder gage in air gap. (c) Clean commutator if necessary. (d) Inspect brushes and shunts, see that brushes fit properly to commutator and in brush holder. See that holders are not worn and that shunts are in good condition, that no copper is embedded in brush surfaces. Repair defects or renew brushes. (e) Lubricate bearings and see that oiling device is in good condition. (f) Make any other repairs necessary. (g) Blow out with compressed air.

Compressor Governor and Governor Switch—(a) Inspect contacts. Dress or renew if necessary. Examine shunts. (b) Clean switch piston insulator. (c) Test operation. Adjust for pressure desired, if necessary, or renew diaphragm.

Switchboard—(a) Clean panel. (b) Inspect switches. Dress or tighten contacts as may be necessary. (c) Inspect fuses. Renew defective ones. See that they are properly held by clips.

Headlights and Headlight Resistances—(a) Clean lens and reflector. (b) Renew lens if necessary. (c) Inspect connections and resistance, and test if necessary. (d) Test headlight.

Heater and Heater Wiring (During Heating Season Only)—(a) Inspect heater connections. Tighten if necessary. (b) Test heaters. Repair or renew defective parts.

All Auxiliary Apparatus and Circuits—(a) Test all auxiliary apparatus and circuits with 35,000-ohm magneto, or 1,000 volts, for shorts and grounds. Repair all defects found.

Fan and Intake Box—(a) Check fan for vibration and repair if necessary. (b) Open intake box. Remove air straining device if used, and replace with clean one, after blowing out box thoroughly with compressed air.

Miscellaneous apparatus—(a) Inspect all apparatus not mentioned and place in good condition.

Blowing Out With Compressed Air—(a) After completion of inspection and repairs, all apparatus should be thoroughly blown out with dry compressed air, taking care not to use sufficient pressure to damage insulation.

6. At heavy inspection periods, in addition to the above work, the following shall be done:

Main Motors—(a) Test all parts with 1,000 volts alternating current to ground for one minute. (b) Clean string bands and paint with insulating paint or varnish if needed.

Main Motor Wiring, Including Bus Jumpers—(a) Test all motors, motor circuit wiring, and connected apparatus, with 1,000 volts alternating current to ground for one minute.

Circuit Breakers—(a) Clean and oil all moving parts. Clean and oil piston, renewing packing cup if needed. Remove valve magnet armature and valves, cleaning and repairing as needed. (b) Test breaker under load to see that it opens at proper current.

Reverser—(a) Clean and oil all moving parts. Clean and oil pistons, renewing packing cups if needed. Remove valve magnet armatures and valves, cleaning and repairing as needed.

Switch Group or Contactors—(a) Remove magnet valve armature and valves, clean and repair as needed. (b) Give interlocks and fingers special attention. (c) Replace leaking packing cups.

Pantographs and Connections—(a) Clean insulators of high voltage-pantographs and test with megger. (b) Test insulation of low voltage pantographs, with 1,000 volts alternating current to ground for one minute. (c) Clean and lubricate cylinders of high voltage pantographs every fifth inspection, and of low voltage pantographs every tenth inspection.

Third Rail Shoe Leads and Shoes—(a) Remove tape from terminals and examine for broken wires or defective soldering. Repair as needed and re-tape. (b) Clean and paint shoe beams with black asphaltum paint. (c) Test shoes and cables with 1,000 volts alternating current to ground for one minute.

Main and Regenerative Control Circuits and Electrical Connections to Air Brake Apparatus, Including Jumpers—(a) All control wiring and connected apparatus shall be tested for grounds and shorts with alternating current, as follows: Battery control equipment, 500 volts; line control equipment, 1,000 volts.

Control Jumpers—(a) At least once each year all train line jumpers to be removed from service, cleaned and repaired. A current of 45 amperes for $\frac{1}{2}$ minute shall be applied to all wires as a test for fractured cable strands and loose connections.

Edison Batteries—(a) Clean tops and outside of Edison cells with dry compressed air or dry steam. Coat top of cans with heavy vaseline and seats of valve caps lightly with Edison battery oil.

Lead Batteries—(a) Remove battery, and after filling each cell to proper level with distilled water, give the battery an overcharge at normal rate for at least one hour after the specific gravity for each cell has become constant. After this overcharge, adjust gravity in each cell.

Compressor and Blower Motors—(a) Test with 1,000 volts alternating current to ground for one minute.

Motor Generator Sets—(a) Remove motor generator, clean, repair and paint as found necessary, test windings by applying 800 volts alternating current for a period of 30 seconds on the alternating current end and 500 volts alternating current for a period of 30 seconds on the direct current end. (b) Replace on car or locomotive and check output on direct current end with ammeter and voltmeter.

All Auxiliary Apparatus and Circuits—(a) Test with 1,000 volts alternating current to ground for one minute.

7. At class repairs, in addition to the work done at regular and heavy inspections (except voltage tests) the following shall be done:

Main Motors—(a) Inspect motor shaft for wear, etc. Renew if necessary. (b) Remove armature, clean, dip in insulating paint and bake. (c) Renew band wires if necessary. (d) Turn commutators and undercut. (e) Inspect, clean and paint motor housing. (f) Clean, dip in insulating paint and bake motor fields. (g) Inspect armature and axle bearings. Renew or repair as may be necessary. (h) Inspect pinions for wear and defects. Renew if necessary. (i) Inspect gears and flexible drive for wear and defects. Renew any parts found unfit for service. (j) Inspect all bolts and suspension parts. Repair or renew as needed.

Main Motors and Main Motor Circuits—(a) Test insulation resistance with megger before and after voltage test. (b) Apply 1,500 volts alternating current momentarily and 1,000 volts for one minute. (c) Clean and paint all cables.

Main Transformers and Impedance Coils—(a) Remove from car, clean thoroughly. (b) Paint all connections. (c) Test windings with megger. (d) Replace on car.

Circuit Breaker—(a) Remove circuit breaker, clean, dip and bake coils. Place in good mechanical and electrical condition. Renew worn parts as needed.

Main and Regenerative Control Circuits and Apparatus—(a) Remove switch groups or contactors, master controllers, relays, etc. Entirely dismantle and overhaul. Adjust tension of fingers and clean interlock contacts. Adjust magnet valves, replacing parts as needed. Replace packing cups in all air cylinders and renew contact tips and arc chutes as needed. Repair worn parts of switches or contractors. Dip and bake contractor coils. In assembling, see that all parts are in adjustment. (b) Test control parts of battery control equipment with 500 volts to ground for one minute. Test control parts of line control equipment; and main current parts of all equipment, with 1,500 volts momentarily to ground, followed by 1,000 volts to ground for one minute. (c) Test insulation resistance with megger before and after voltage test.

Blower and Compressor Motors and Motor Generator Sets—(a) Remove and dismantle. (b) Clean, dip and bake armatures and fields. (c) Clean and paint frames and leads. (d) Turn commutators and undercut if needed. (e) Renew band wires if needed. (f) Examine bearings and renew if worn. (g) Re-assemble and test with 1,500 volts alternating current momentarily to ground, followed by 1,000 volts alternating current to ground for one minute.

Other Apparatus and Circuits—(a) Dismantle, overhaul, and place in first class condition. Inspect wiring for chafed or broken places, loose terminals and defective taping. Repair or replace as needed.

Edison Batteries—(a) Clean tops and sides with dry steam to remove all foreign matter and loose paint. (b) Dip in suitable insulating paint to coat bottoms and sides of cans and crate, but not tops of cans. (c) Test for capacity. (d) Renew solution if needed. (e) Replace defective cells and fully charge battery.

Lead Batteries—(a) Remove the battery and dismantle entirely. Wash out sediment and clean plates. Straighten or replace buckled and worn plates, replace defective separators, test jars for leakage, repair or replace weak crates, reassemble and fill with new electrolyte, overcharge for at least one hour and adjust gravity of electrolyte.

All Equipment—After assembling on locomotive or car, test all apparatus and connected wiring as follows: (a) Apparatus and wiring carrying power current, 1,500 volts alternating current to

ground and between circuits momentarily followed by 1,000 volts alternating current to ground for one minute. Test with megger before and after voltage test. (b) Control apparatus and wiring on line control equipment, 1,500 volts alternating current to ground momentarily followed by 1,000 volts alternating current to ground for one minute. In addition, test between all circuits with 1,000 volts alternating current momentarily. Test with megger before and after voltage tests. (c) Control apparatus on battery control equipment, 500 volts to ground for one minute. In addition, test between all circuits with 500 volts momentarily. Test with megger before and after voltage tests.

The members of the committee are: G. C. Bishop (Chairman), Long Island; W. L. Bean, N. Y., N. H. & H.; J. H. Davis, Electrical Engineer, B. & O.; J. V. B. Duer, Pennsylvania; A. Kearney, Superintendent Motive Power, N. & W.; C. H. Quereau, N. Y. C., and L. K. Sillcox, C. M. & St. P.

Discussion

J. H. Davis (B. & O.): I did not come prepared to present this paper, thinking that Mr. Bishop, the chairman, would do so. There has been no meeting of the committee, and Mr. Bishop prepared the information and submitted it to the committee members.

There has been some criticism relative to recommending these rules, or submitting them as recommended. No provision has been made for the daily inspection of electrical equipment for either locomotives or multiple unit cars. I believe it would be well for the committee to consider a revision of the paper and provide for further inspections.

In general these specifications or instructions are applicable to any class of equipment. Reference is made to the third-rail shoe and other fuses. I believe the committee will want to modify that a little. What we are really trying to cover is fuses as well as third-rail shoes.

I believe that this paper, when finally prepared and put into a little better shape, will be a valuable one for the member companies having to do with the operation and maintenance of electrical locomotives and multiple cars and I hope there may be some discussion in order that the committee in making any revision may have before it all the information possible.

Chairman Coleman: The committee would like to review this paper, possibly, for another year. It is now before you for discussion and a motion would be in order to accept the paper to be printed in the proceedings and the committee continued for further investigation, to prepare a full report next year.

Mr. Giles: *I move that the paper be accepted and printed in the proceedings and the committee continued.*

Mr. Oviatt: It will be noted that the committee has specified certain mileages and still leaves it optional with the operating officials to determine the extension of that mileage before the inspection is made. From my knowledge of this class of equipment one of the most important things is an inspection based upon definite mileage; in other words, to find out your troubles before they really happen. This refers to mighty important electrical equipment and I would second the motion that the committee be continued and this paper brought before the convention next year with not only definite recommendations as to the mileage, but more complete material in line with the suggestions as to inspection, maintenance and so forth.

Questions Wisdom of Proposed Instructions

L. K. Sillcox, (C. M. & St. P.): In general, a uniform set of instructions for the maintenance of electrical equipment of rolling stock is, at least under the present conditions, neither feasible nor desirable. Such rules or instructions must have as their purpose either one or both of the following objects: 1. The standardization of maintenance practice. 2. To serve as a guide for a set of instructions to those roads which are in a position to need such assistance.

With the first object in mind, I believe that the tendency to comprehend under uniform rules complex and often dissimilar equipment operating under dissimilar conditions and which particularly as regards locomotives, is not and, in the present state of the art, cannot be standard, is to be deplored. I am heartily in accord with the standardization, not only on paper but actually in practice, of those things which in their use and application are universal enough and similar enough to make their standardization profitable, but do not believe that the proposed attempt comes

into this class. The resulting rules can, at best, be but a compromise and actual practice will vary just the same.

A competent management will adhere to a program based upon its own experience or the expert experience of those familiar with the problem. If the proposed rules are intended for the guidance of those contemplating electrification, their value will be questionable as, owing to the fact that certain items cover certain types only, it will not be known which are applicable and which are not, without the advice or under the direction of those having experience, in which case the rules would be unnecessary. In any event, the maintenance work will actually have to be done by men who are experienced in such work, and to them many of the detail instructions, covering operations required and involved in maintenance, will appear superfluous and unnecessary.

The most feasible and profitable way for any road to handle the standardization of maintenance, either of methods at one shop or as regards uniformity at the different shops of the road, is through meetings at which are represented those who are connected with the operation and therefore in the best position to determine the questions involved and keep the situation lined up to the requirements as they develop. This might be supplemented by occasional interchange visits of proper supervisors of the different roads, so that proper improvements in methods or practice developed in a particular case may, if applicable, be mutually taken advantage of.

It will be seen from the above that I question the soundness of the principle of the proposed instructions, feeling that the latter cannot be laid down with the specificness attempted, for the equipment and conditions varying so widely, and still possess the value which A. R. A. rules, etc., should possess.

Suggests an Alternative Course

If the urge for the standardization of maintenance, under such dissimilar conditions, cannot be resisted, the following alternative course might be considered:

Agree to what is meant by the terms "regular inspection," "heavy inspections," "class repairs," etc., as applied to electrical equipment and as is undertaken in your pamphlet, "Steam and Electric Locomotive Repairs," June, 1921; develop the character of the work usually covered under each term and, if desired, supplement this with a statement by each road covering, in general, the character of equipment it maintains, and its usual maintenance practices.

The proposed instructions, outside of the length of periods, are fairly comprehensive for 750-V. direct current locomotives or multiple-unit equipment and the low-voltage and the high-voltage alternating current locomotives and multiple-unit equipments, but do not fairly comprehend the high-voltage direct current locomotives or multiple-unit equipments or the high-voltage end of alternating current locomotives. If these could be eliminated, then the objections might be less.

Disregarding the views, as expressed above, the following general comments are made on the rules as they stand:

Comments on Proposed Rules

Introduction. The wording of the first sentence does not make clear, it seems to me, what the purpose of the instructions may be. Are they considered as the result of investigation of the practices existing on different railroads to represent the best practice, and is it the intention that the different roads joining in the investigation are in the future to be governed by them? Or, are the rules gotten up merely for the guidance of those roads which do not have an organization suitably experienced to evolve their own set of rules? The instructions are stated to be based "on the experience and actual practice of those roads having electrically equipped rolling stock." What roads, then, are the "other" roads referred to?

I think that the wording of the first sentence is misleading, as in many cases, at least as far as our railway is concerned, practice deviates from that indicated by the suggested rules more than the use of the modifying words "based" and "general" justify.

I think it might be inferred from the third sentence in the introduction that the roads participating in the preparation of the instructions have agreed to adopt them as general practice with but minor modifications, whereas I think it will be found where the best maintenance obtains, that the modification "to suit location conditions" will govern, rather than the practice outlined.

I presume "to suit local conditions" comprehends differences in policy with respect to standard of maintenance, etc.

The last sentence might be considered as implying that no additions to the instructions would be necessary except those required to insure safety to the workmen. This, we are sure, cannot be intended. The additional detailed instructions which must be issued adequately to cover the type of equipment used on a particular railroad would comprise a very appreciable addition to the general rules.

Article 1: This is not quite clear. Does it mean that all the rules do not apply to all classes of equipment and only the rules that fit a particular class of equipment are to be deemed applicable?

Article 2: Inasmuch as it is left to each road, and properly should be if the most economical and satisfactory results are to be obtained, to determine the suitable mileage figure, I do not quite see the desirability of giving a fixed figure. Moreover, there may be in individual cases, other bases which would determine the inspection period, rather than the mileage basis; for instance, particularly in the class of multiple-unit systems. Here the practice of inspecting after the use of a certain number of kilowatt-hours is looked upon with favor. I do not mean to intimate that this would be a desirable basis in all cases, but to emphasize the point that circumstances alter cases.

As only two classes of inspection are covered (the current inspection given a locomotive when it reaches a terminus and goes into the engine house apparently being disregarded), the inference would be that usually there is no other inspection given or required. I presume this is not the intention.

Article 3: I consider the periods given as too arbitrary; they should at least be modified by some such additional wording as, "or as many as operating experience may indicate to be best and most economical."

Article 4: General remarks above apply. The use of the word "shall" in the instructions indicates compulsion and we believe is out of place; but particularly objectionable with respect to Article 4. The reason a railway makes classified repairs at a certain time, or after a certain period of mileage, or after something else, is because it needs to, the necessity being determined as indicated by an unusual number of failures, or by observation of general conditions, or by past experience either with the equipment or similar equipment in a given service, and not because it happens to be a rule which has been agreed upon.

With respect to "Class Repairs," we are not clear as to how the use of this term corresponds to its use in your pamphlet of June, 1921, in which the class of repairs is based essentially on the character of the work necessary, rather than on mileage, the latter being referred to merely as an expectancy.

Regular Inspection, Heavy

Inspection and Class Repairs

Testing Insulation. Under regular inspection, main motors, etc., it is stated, "Test insulation resistance with 35,000 ohm magneto,

or with 1,000 V to ground for one minute, for short circuits and grounds." What might be intended is first roughly to test the insulation resistance by 35,000 ohm magneto to ground or between isolated circuits, or to test the di-electric strength of insulation to ground or between circuits. If no di-electric test is intended by the use of 1,000 V. (a. c. or d. c. not specified), then a voltmeter, or megger, would of course be implied, unless only an indication of a complete breakdown is wanted. If no di-electric test is wanted, then a time interval is of no value. If di-electric test is wanted, then the voltage, to do any good, would depend upon the character of the insulation and the voltage for which it is designed. Incidentally, under heavy inspection a. c. voltage is specified.

Regular Inspection, Main Motor and Motor Wiring, etc. If it is intended to apply proper a. c. voltage for one minute to interconnected d. c. machines, certain voltages detrimental to the insulation may be set up if the current is taken from transformers, etc., having a steep wave front and if the inductance and capacity of the circuits bear certain relations.

The clarifying of the intention, as above, of the use of suitable high potential, instead of 1,000-Volt a. c. or di-electric test, and the cautioning against the improper use of a. c. voltage for interconnected d.c. circuits is recommended.

General: R. I. (Regular Inspection) and H. I. (Heavy Inspection). In some cases only inspection is called and no rectification. Should not a uniform form be adhered to?

R. I. and H. I. In some cases inspection is called for under a sub-letter and then the following subs cover detail which is really comprehended by the general term of the preceding sub referred to.

R. I. and H. I.—Pantograph. Why differentiate between the inspections, adjustments, cleaning, etc. (except insulators), between high and low voltage, between a. c. and d. c.? What is high voltage? What is low voltage? What about lubrication of pantograph shoes?

R. I.—Fuses. What about inspection as to proper size as well as proper number of fuses?

R. I.—Lightning Arresters. What about height and condition of electrolyte? What about removal of lightning arresters in winter?

H. I.—M. G. Sets. Why remove M. G. sets? Why check output?

C. R.—Main Motors. Is it necessary or desirable to take out field coils? Is it necessary or desirable to turn and under-cut commutators? We have many that have never been turned.

C. R.—Circuit Breakers. Is it necessary or desirable, particularly in the case of low voltage control, to remove coils and re-insulate unless necessity is indicated by test or otherwise?

C. R.—Main and Regenerative Control Circuits and Apparatus. Is it necessary to remove and dismantle contactors, etc.?

C. R.—Compressor Motors and M. G. Sets. Is it necessary or desirable to remove field coils?

(The question was then called for, put and carried.)



The Report of the Arbitration Committee

Responsibility for Car Conditions to Meet Interchange Requirements of Rule 3 Placed on Owner

DURING THE YEAR Cases 1233 to 1286, inclusive, have been decided and copies sent to the members. A vote of concurrence is requested by the committee.

With the approval of the General Committee, the committee has discontinued the rendering of interpretations of questions under the Rules of Interchange and considers only those disputes presented in the form of arbitration cases in accordance with Rule 123. This change in practice has been of great benefit to the committee and also to the members as all arbitration cases are published and the decision thus made available for the guidance of all the members.

Recommended Changes in the Rules of Interchange

Changes or additions in the text of the rules, as far as possible, are shown in italics.

RULE 2

The committee recommends that Section (b), third paragraph, of this rule be modified to read in accordance with proposed form shown below, to improve the handling of such cars:

"A leaky tank car shall have stenciled *on both sides*, in letters three inches in size, adjacent to the car number, the words 'Leaky tank. Do not load until repaired,' and the owner shall be immediately notified. Stenciling must not be removed until the tank is repaired."

The committee recommends that a new paragraph be added to Section (f) of this rule as follows:

"*For inside door protection, the car transfer check as shown on page 172, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section G. A. R. A. Car Service Rule 14.)*"

This change is to conform to joint recommendation of Committee on Car Service of the Transportation Division and Arbitration Committee, Mechanical Division, making originating road responsible for absence of or improper inside door protection. This recommendation has been approved by the general committees of both Divisions and the necessary changes in Car Service Rule 14 were approved at the session of the Transportation Division at Chicago, April 25, 1923.

The committee recommends that Section (h) of this rule and form, Authority for Transfer or Adjustment of Lading, be modified as shown below, to provide that, when used as a bill it will show that the work was performed:

"The car transfer check authorizing transfer or rearrangement of lading be of the form shown on page 172. *All of the information required by the reading of the form must be filled in.*"

[The billing instructions at the side of the form are changed to provide that the form itself may be used as a bill.—EDITOR.]

RULE 3

The committee recommends that the effective date of Sections (b) and (d), second paragraphs, be extended to January 1, 1925. It is felt that the present situation justifies these extensions.

To prevent the transfer of lading enroute and to enable car owner to apply device which has been adopted as standard for his cars, the committee recommends that Section (f) be modified to read in accordance with proposed form shown below:

"After January 1, 1924, no refrigerator car equipped with brine tanks will be accepted *from owner* unless provided with suitable device for retaining the brine between icing stations."

The committee recommends that the effective date of Section (i) be extended to January 1, 1925, and that the section be modified to read in accordance with proposed form shown below:

"After January 1, 1925, cars with trucks of less than 60,000 lb. capacity will not be accepted *from owner* unless equipped with wooden or metal draft arms extending beyond the body bolster, metal draft arms integral with body bolster, metal draft arms extending to metal body bolster and securely riveted to same, or transom draft gear."

The present situation justifies this extension. It is also felt that transfer of lading enroute should be prevented and car owner held responsible for compliance with the rules.

The committee recommends that the effective date in the second sentence of Section (i) be extended to January 1, 1925.

To prevent the transfer of lading enroute and to require car owner to comply with the rules, the committee recommends that Section (o) be modified in accordance with proposed form shown below:

"(o) Cars built after November 1, 1920, will not be accepted *from owner* unless equipped with 6-in. by 8-in. shank A. R. A. Standard Type D couplers."

RULE 9

The committee recommends that the following new paragraph be added to this rule:

"*When charge is made for adjusting safety valves on tank cars, billing repair card must specify the pounds pressure at which the valve opened before adjusting.*"

It is felt that this information should be given the car owner to justify bill for adjusting safety valves.

RULE 17

To conform to the recommendation of the Committee on Wheels, the committee recommends that a new section be added to this rule to be designated as Section (i) and to read as follows:

"*The application of cast iron wheels cast after June 30, 1924, of nominal weight less than 650 lb., 700 lb. and 750 lb. shall be considered as improper repairs.*"

The committee recommends that Interpretation No. 7 of this rule be modified in accordance with proposed form shown below:

"(7) Q.—(No change.)

"A.—The substitution of the Schaeffer patented brake lever connection does not constitute wrong repairs. If such connection is not standard to any of owner's cars, charge for same should not exceed cost of that of owner's standard."

It is reasonable for the car owner to accept charge for this device where used by the owner, even though not yet applied to the particular car in question.

RULE 30

To remove present inconsistency, the committee recommends that Section (c) of this rule be modified in accordance with proposed form shown below:

"(c) Wooden and steel underframe cars (except refrigerator cars) should be re-weighed and re-marked each year during the first two years the car is in service, and thereafter once every 24 months. All-steel cars and all refrigerator cars should be re-weighed and re-marked at least once every 36 months. *Such re-weighing and re-marking may be done after expiration of 18 months (for wooden and steel underframe cars) and 30 months (for all-steel and all refrigerator cars) from the month in which previous weight was obtained.* This paragraph does not apply to tank cars."

RULE 32

The committee recommends that a new item, "discharge valve caps," be added to the first paragraph of this rule.

The committee recommends that Item 4 of Section (d) be modified to read as shown below:

"(d) 4. No rider protection, when necessary, if car is damaged to the extent shown in footnote to Rule 43."

The committee recommends the following interpretation to Section (d), Item 3, of this rule:

"Q.—Does this apply to cases of damage to cars in hump switching where rider protection is furnished?"

"A.—No. This provision is intended to refer to wharves or other inclines on which cars are not handled with rider protection."

These changes and interpretation are to improve and clarify the rule.

RULE 33

To clarify this rule, the committee recommends that the first paragraph be modified as shown below:

"Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except damage to running boards (*including their supports and attachments*) on tank cars when sideswiped or cornered."

RULE 58

The committee recommends the following interpretation to this rule:

"Q.—Is car owner responsible for damage to air brake hose, angle cock or train line due to couplers passing?"

"A.—Yes, unless otherwise provided in Rule 32."

RULE 72

The committee recommends that this rule be modified as shown below:

(*Owners responsible.*) "Any seam running lengthwise and within the limits of 3½ in. from flange, as shown in Fig. 5."

This is recommended by the Committee on Wheels, as all longitudinal seams are dangerous regardless of apparent small extent on surface.

RULE 98

The committee will designate all paragraphs of this rule with letters for ready reference, and recommends that a paragraph be added to this rule reading as follows:

"If new cast iron or new cast steel wheels are applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand wheels whether or not a defect card is involved. Similarly, if new A. R. A. standard axle is applied account delivering line defect on wheel or axle or both, owner may be charged for the difference in value between new and second-hand axle whether or not defect card is involved."

Owner receives the betterment and would not be penalized in being billed for it. Also, it creates incentive to apply new material which is preferred by car owner and because it is in line with rule on wrought steel wheels.

RULE 111

The committee recommends that the following note be added to this rule in order to make it more clear:

"Note: In cases where annual air brake cleaning is not performed, but triple valve is renewed account of defective body, charge may be made for material only. Also in such case if brake cylinder, brake cylinder piston or non-pressure head are renewed, account of defective, charge may be made for material and labor."

RULE 112

Attention has been called to a misprint in Note 1 to this rule as shown near top of page 161 of the 1922 Code.

This note should read as follows and will be corrected in the first supplement to the rule issued:

"Note 1—These rules are for the purpose of settlement between carriers and between carriers and private lines, for destroyed or dismantled cars, handled under the Rules of Interchange, and are not intended to be applied to cars of the same particular types in the accounts of individual carriers."

The committee recommends that a new paragraph be added as the third paragraph of this rule reading as follows:

"Second hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value."

The members of the committee are T. H. Goodnow, chairman, C. & N. W.; J. J. Hennessey, C. M. & St. P.; J. Coleman, Canadian National; F. W. Brazier, N. Y. C.; T. W. Demarest, Pennsylvania, and G. F. Laughlin, Armour Car Lines.

Discussion

T. H. Goodnow (C. & N. W.): The committee has withdrawn the paragraph contained on the last page of the report under Rule 112, reading as follows: "Second-hand trucks used under new car bodies or new trucks used under old car bodies shall be considered as of the same age as the car body in figuring depreciated value," and substitutes the following: "The age of trucks, in settling for destroyed cars, shall be considered the same as that of the car body."

In connection with that last paragraph, the sub-committee on billing data will make a report and in accordance with whatever action you take on that report the Arbitration Committee will frame certain rules to be included in the interchange rules so that the provisions of that report will be carried out.

H. T. Bentley (C. & N. W.): I move that the report of the Arbitration Committee be accepted, with the amendment or change which it proposes in the report.

(The motion was duly seconded and carried.)

R. L. Kleine (Penn. System): The report of the sub-committee on regulations governing inspection and repairs of foreign cars and billing therefor under the A. R. A. rules of interchange has already been approved by the Arbitration Committee and it was also submitted to the General Committee and received its approval and went to the board of directors, which approved the principles involved but left to the association any changes that it might wish to make in the details. The purpose of the report is to correct some of the things that the Inspection Bureau of the Association is finding.

In general these inspectors find that in-so-far as the billing itself is concerned it is being carried out fairly well, and that not much exception can be taken to it, but in-so-far as the mechanical details and the originating records are concerned there is room for improvement, and this report is for the purpose of giving to all railroads an approved method. I will read the principles and that part of the report that relates to the mechanical details. [Mr. Kleine here read from the proposed regulations, the purpose of which is to provide a correct basic method of recording the repairs made and material applied to foreign cars; a system of records sufficient to insure correct determination of responsibility for the repairs, according to the interchange rules; and also the proper preparation and handling of the billing covering the cost and responsibility for repairs. The regulations include instructions for systematic checking of the way in which repairs and the billing therefor is being handled, the results of which are to be available to the A. R. A. Mechanical Inspection department. A system of refunding for improper charges discovered by these checks is outlined and a number of forms designed to show the minimum information required to carry out the purpose of the regulations are included.—Editor.]

Chairman Coleman: You have heard the report. What disposition do you want to make of it?

J. J. Tatum (B. & O.): I move that the report be accepted and referred to the Arbitration Committee so that it can make the necessary changes in the rules of interchange to make them effective.

F. W. Brazier (N. Y. C.): We should not let this report go by without paying a compliment to Mr. Kleine. It is one of the best reports that has been gotten up and I believe it is going to clear the atmosphere on these questions. Possibly it is going to mean a lot more work for you to carry out the recommendations contained in the report, but it is going to be decidedly worth while in the end.

(A motion was carried to accept the report and refer it to the Arbitration Committee and to be embodied in the rules. A rising vote of thanks was then extended to Mr. Kleine for his very able report.)

Mr. Kleine: I want to thank you for this honor and to say in justice that it does not belong to me. It belongs to the sub-committee of the Arbitration Committee and the inspectors of your Interchange Bureau. They have done all the work and they have prepared it. I have simply been the coordinating officer.

IN THE DERAILMENT of a passenger train on the Canadian National near Jardine Brook, New Brunswick, on June 19, two coaches fell down a bank and 12 passengers were injured.

THE PLANS FOR REMOVING GRADE CROSSINGS and making other extensive railroad improvements in the southern part of Philadelphia—elaborate plans involving both the Pennsylvania and the Baltimore & Ohio, based on studies and negotiations which have been going on for several years—have been finally completed and have received the approval of the Pennsylvania Public Service Commission. One of the first features of the work to be begun will be the elevation of the tracks on Washington avenue, and the continuation of this line on Gray's Ferry avenue between Fifth and Thirty-first streets.

Co-operative Research in the Railroad Field

Request for Research Bureau Recommended to General Committee—Support of Universities Pledged

After an animated discussion on the subject of Co-operative Research, which was participated in by railroad members and also by representatives of several important universities, a motion was passed referring the matter to the General Committee of the A. R. A. for further action. The resolution carried a strong endorsement by the Mechanical Division of the proposed plans for a co-operative research bureau.

W. J. Bohan

Assistant General Mechanical Superintendent, Northern Pacific

A comprehensive treatment which so important a subject as that of co-operative research from the railroad standpoint should receive is hardly possible in the time allotted. A brief mention, however, of a few points, which may perhaps be considered the high spots, is offered in the hope that it may be the beginning of aggressive activity in a direction too little known not only in the railroad field but in most commercial fields. It is appreciated that this is a rather broad statement but it is believed that careful inquiry will show it to be substantially correct.

Two generals, "General Opinion" and "General Statement" both very unreliable, have too much voice in the present tactics of the business army; it is gratifying to note that economic pressure is urging that these generals be superseded.

Research is diligent protracted investigation and studious inquiry to determine *facts*. Co-operative research is the combined activity of one or more individuals or organizations in that direction. It is understood in this particular instance that the co-operation suggested will be between the different railroads and the universities.

Fixed fundamentals must be recognized in order to establish co-operative research on a basis that will be productive of conclusive, satisfactory, and practical results in the acquirement of useful knowledge and its application to more economical and efficient operation. The research must be *operative* as well as co-operative. There must be a meeting of minds, a full understanding and agreement not only to render real assistance in the research work itself but to abide by the conclusions reached and make them effective. If this is not done, any effort at co-operation will result in failure. When this agreement is reached, a carefully worked out organization is necessary to conduct the work and submit the findings and recommendations. This organization should be well balanced technically and practically and it *must* be composed of men having trained analytical minds; minds trained both in technical schools and in the school of experience.

The field of activity of the organization should be unlimited and cover the whole range of questions from selection of proper materials and appliances, power and fuel, shops and terminals, engineering and maintenance-of-way, general and divisional operation, freight and passenger transportation, including their sale, accounting, etc., etc., to the deeper social and financial problems.

Most sound and permanent fruitage is obtained by careful planting and by gradual well cultivated growth. In order, therefore, that co-operative research may not fail, it seems best that a conservative start should be made by undertaking one or two subjects such as "Fuel," and "Material and Supplies." Fuel is mentioned as a separate item as it is of sufficient importance to be so considered.

The organization for co-operative research, as previously stated, must be operative and be unhampered; and it must also show real profit on the investment. It seems self-evident, therefore, that it should be detached from the forces regularly engaged in the routine of operation and its work should not embarrass or retard that operation.

The development of this organization should be approached with analytical thought and care. Two schemes of organization may be mentioned in a general way. One, a centralized institution to handle the work for all the railroads; the other, separate organizations on each railroad distributing their findings through

a central bureau. The first has the advantages of being under one head and the possible disadvantages of being cumbersome, top-heavy and provincial, and the fact that its success is absolutely dependent on agreement of all the railroads to rely upon the organization. This may be found difficult to accomplish. The second has the disadvantages of handling a large number of organizations but has the advantages of being cosmopolitan and the fact that each road, knowing its own property best, has possibilities of contributing greater knowledge for the general good. Both plans probably would require about equal expenditures to handle. Each has its advantages. No plan should be put into effect until carefully worked out. Co-operative research is a step forward and some plan should receive early consideration. It will net handsome returns.

Prof. E. C. Schmidt

University of Illinois

Certainly the members of this organization do not need to be urged or argued with concerning the importance of research. The proceedings of the Mechanical Division and the 90 odd volumes of the Master Mechanics' and Master Car Builders' Association are an impressive record of the very extensive research in motive power problems which this organization has carried on for 40 years, and there is a similarly impressive record in other fields of railway work in the volumes of the proceedings of the American Railway Engineering Association, the Fuel Association, and many other railroad organizations. I suppose in the past, however, there has been some lack of co-ordination certainly between these organizations, some lack of organization in the problems to be undertaken, some overlapping, so that any movement towards general co-operation in research and general co-ordination of this work is very timely.

The consideration of this subject is certainly gratifying to those of us who have been trying to plant this idea for a number of years. I do not know what form the co-operation contemplated may take but whatever the form—whether it be merely co-operation between the various railroads so that research may go forward under the control of some such a body as the Mechanical Division, or whether it be co-operation between the railroads and some of the established laboratories—it makes no difference, it seems to me.

The effort towards co-operation is one which ought to prevent overlapping and find the common problems. There certainly are a lot of them despite the great volume of work that has been done already. Everybody will agree, I think, that the work can't stop. There is much more to be done in the future than has been done in the past.

There are innumerable problems connected with fuel and the use of fuel; with locomotive design, especially boiler design with reference to the use of fuel; problems related to draft appliances, and I could go on, I suppose, for 10 minutes enumerating problems of common research in further experimentation and study; and certainly among all those problems, there are a great number that are of common interest to all the railroads of the country; in fact, to form a program for co-operative research in which all railroads would be equally interested, and upon which all would stand. In this work, co-operation should take the form of co-operation with established laboratories—those of the various universities of the country, as well as those like the one at Altoona.

Fifteen years ago the University of Illinois undertook adequately to provide for the training of men for railway service, and adequately to provide for the study of railway problems. Since then we have built up facilities for testing both in our locomotive laboratories and on the road, and are prepared right now to do a good deal of work in this field, especially in the motive power field.

I am authorized to say that if this Association, or any other railroad association, wants the assistance of the University of Illinois—wants us to come in on any such a scheme—we are not

only ready to do so, but are anxious and willing to do everything in our power (applause).

Prof. Reubenkoenig
Purdue University

It seems to me that in bringing up this question of co-operative research the members of the American Railway Association have come to a realization of the needs of a closer co-operation between the railroads and the technical schools. I do not need to recall to you in this instance the work that has been done at Purdue University during the past 30 years, but I do wish to remind the members that we still have the air brake rack, the brake shoe machine and the drop test machine.

For several years efforts have been made at Purdue University to secure a building that will adequately house the priceless collection of all locomotives that have been accumulated through the tireless efforts of Dr. Goss. I am sorry to report now that nothing definite has been done towards this, and it may seem that there is no particular interest in this matter, but I believe a re-awakening of interest in the value of co-operative research will also carry with it a realization of the value of these historical locomotives as typical milestones in American railway progress.

Our efforts toward modernization of railway equipment at Purdue University have not been entirely without results. When our Schenectady No 3 emerges from the shops of the Monon at LaFayette, it will be practically a new locomotive as far as the type is concerned. There has been donated towards this cause approximately \$8,000 worth of material. Although this will be a modern locomotive of the American type, it is not modern as far as the size is concerned.

Furthermore, there are now tentative plans for a transportation building at Purdue University. This building will take care of these old locomotives and at the same time afford provision for the installation of a modern locomotive testing plant. We hope to have there equipment of sufficient capacity to test a Santa Fe type locomotive. I have no doubt that a re-awakened interest in co-operative research on the part of railways will serve to hasten the development of these plans. There has always existed the closest co-operation between the railroads running through LaFayette, notably the Monon and the Big Four, and Purdue University.

I merely mention these instances of what is possible in the line of co-operation between the railroads and the technical schools. I wish to assure you that Purdue University will stand ready at all times to co-operate to the fullest extent in any work that may be required of us in the furtherance of an intensive program of co-operative research.

Other Discussion

C. B. Smith (B. & M.): I am speaking for our assistant general manager, L. G. Coleman, who was unable to remain over for the discussion on this subject and to say for him, as well as I may, that he is very much interested in the subject of co-operative research and would have expressed the opinion that if it were possible for the American Railway Association to take up this matter actively it would be strongly favored by the Boston & Maine. There are a large number of railway systems in the country which are not able to have such laboratory and research

facilities as might be developed under the auspices of the American Railway Association.

Such a research bureau should not be confined to the mechanical department. However, we of course can only speak for the Mechanical Division. The idea is that the American Railway Association could properly provide research facilities for more than one department. It is the feeling also that it is not necessary to establish a separate laboratory with full research facilities merely for railway purposes, but that we should make use, so far as it can be arranged, of the existing established laboratories and the other facilities of the technical institutions and private laboratories of the country, thus saving to the railways enormous expense for duplicate facilities.

It is hoped that some definite action may be taken expressing the opinion of this meeting that the Mechanical Division recommend to the general officers through its General Committee of the American Railway Association that it take this matter under careful and active advisement with the hope that something definite can be arrived at on the part of the Association. It is appreciated of course that it is a large subject and should be considered from many angles.

C. F. Giles (L. & N.): I had some conversation yesterday on the subject and one of the gentlemen related the following story, showing the importance that one of the large corporations in this country attaches to research work. They say that the president of this corporation conferred with his subordinates and officials and asked them to recommend to him an engineer or a chemist that had the ability to conduct a research department for his concern. They recommended a certain man who was asked to carry out the work. This man stated that he would need \$3,000,000 with which to carry on the experiments and do the research work. The request was granted immediately. The president then asked the man what he would expect in the way of a salary. The man replied "it doesn't make any difference what sort of a salary you give me just so you give me enough to do this research work." The man has not only expended the \$3,000,000 but has exceeded it.

I am merely relating that to show the importance that some of the big concerns in this country with whom we have dealings attach to this kind of work.

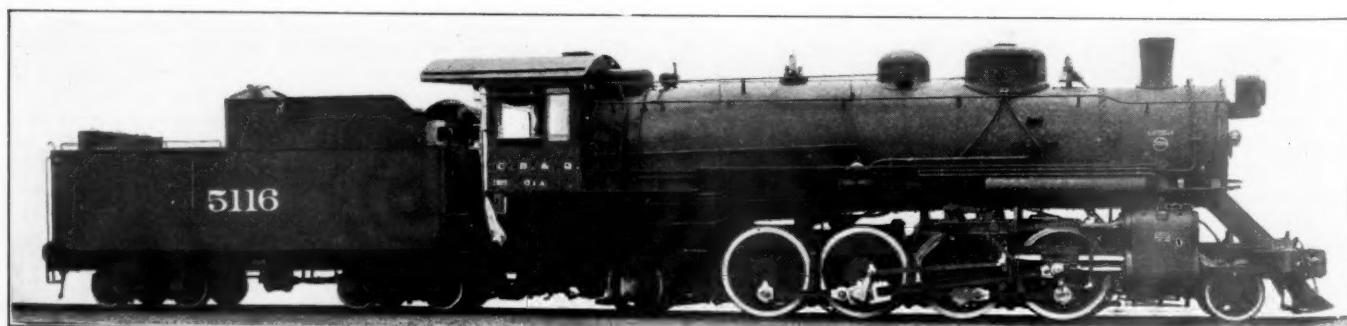
Chairman Purcell: I might say that the General Committee, as well as the fuel conservation committee, has had this subject under consideration for some time.

C. B. Smith (B. & M.): I move it be the sentiment of this meeting that the General Committee of the Mechanical Division be requested to take up actively with the officers of the American Railway Association the consideration of the establishment of a proper co-operative research bureau, and push this matter through to a conclusion acceptable to the Association.

R. L. Kleine (Penn. System): Do you not think it would be better to refer the matter to the General Committee without instructions as to what action they should take? I would like to ask Mr. Smith about that.

Mr. Smith: I would say in answer to Mr. Kleine's question that I think the feeling of our assistant general manager is that something definite should be done at this meeting, and while it is not the purpose of that motion to be mandatory in any sense it is simply to bring out at this session, if it is our will and pleasure, that the General Committee make a definite move on the question. That is all I intended to convey.

(The motion was seconded and carried.)



A Burlington Mikado

Specifications and Tests for Materials

Numerous Changes in Present Requirements—New Specifications for Water Glasses, Hose, etc.

THE COMMITTEE submitted a report on subjects before it for consideration during the past year and in addition to making many changes in the present specifications, recommended new specifications for water glasses, hose and lighting belts.

Sub-Committees

Sub-committees are working on the following specifications which will be reported on next year: (a) Mechanical Rubber Goods, (b) Welding Wire, (c) Water Gage and Lubricator Glasses, (d) Wrought Iron, (e) Steel Sheets for Passenger Equipment and (f) Paints.

Report to the Association in 1921

Since no action has been taken by the association towards promulgating the tentative specifications submitted in this committee's report of 1921 as Exhibit A, Revision of Standard Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks, and Exhibit B, Revision of Standard Specifications for Carbon Steel Castings, the committee withdraws its recommendations and has prepared a new revision of the axle and steel casting specifications submitted herewith for approval.

Recommendations

Revision of Standard Specifications

(a) Specifications for Galvanized Sheets to be revised and changed from standard to recommended practice. The specifications have been revised with the co-operation of the manufacturers and have been changed in form; in providing for a copper bearing base metal when specified; in varying requirements for weight of coating for different gage sheets; reducing requirements for bend test of coatings because of heavier coatings specified and including permissible variations in weight, size and gage.

(b) Specifications for Carbon Steel Axles for Cars, Locomotive Tenders and Engine Trucks to be revised and changed from standard to recommended practice. The specifications have been revised to remove requirements for annealing because the standard practice is to use unannealed axles; the carbon range has been raised slightly in the interest of securing a stiffer axle in the larger sizes; the addition of a requirement for caliper the actual diameter of the test axle; the removal of engine truck axles from this classification, since most of such axles are bought under annealed forging specifications, and the requirements of these specifications are intended for tapered axles; one drop test formula only is given for all lengths of axles; revision of permissible variations allowing somewhat wider tolerances on oversizes on account of difficulties in forging, and the addition of a table of maximum weights for both smooth forged and rough turned axles. These weights have been obtained from weighing of a large number of axles and represent current practice.

(c) Specifications for Steam Heat Hose to be revised and changed from standard to recommended practice. The form of the specifications has been changed and long length as well as car heating hose is covered; the rack steaming test is substituted for the digester test and hydrostatic and deflection tests added; tolerances are given for outside and inside diameters; the physical test requirements for tube and cover and friction have been changed slightly to agree with standard practice but the quality of hose has not been affected.

(d) Specifications for Mild Steel Bars; Structural Steel for Passenger Equipment Cars; and Structural Steel for Freight Equipment Cars to be revised and combined into one specification which includes locomotive material and changed from standard to recommended practice.

Since all the above materials are of the same grade, it seems advisable to combine the specifications into the prevailing form in use by other associations. Chemical requirements are for phosphorus and sulphur and for copper when it is specified; re-

wording of sections on tolerances and other minor changes in wording.

Revision of Recommended Practice Specifications

(a) Specifications for Annealed Carbon Steel Castings for Locomotives and Specifications for Annealed Carbon Steel Castings for Passenger and Freight Equipment Cars to be revised and combined into one specification.

These proposed specifications are the same as those reported as information in this committee's report of 1922 and represent the recommendations of the Joint Committee of this association and the American Society for Testing Materials. These specifications have also been approved by the American Railway Association Car Construction and Coupler Committees. The principal change in these specifications is in the method of expressing the requirements; limits for carbon have been omitted and the form of the physical requirements changed so that minimum yield point is specified while tensile strength is not. The tensile strength is required to be reported, however, as it is necessary that it shall be obtained as the elongation and reduction of area are made a function of the tensile strength.

The committee feels that these specifications represent the best that have yet been offered and recommends that the members of the association put them into force for the purchase of steel castings at the earliest opportunity.

(b) Specifications for Lap-Welded Charcoal Iron Boiler Tubes for Locomotives to be revised. The principal change in these specifications is revision of the tolerances for gage so that the tubes shall be not less than the thickness specified. Some changes were made in the physical test requirements to bring the specifications into harmony with those of the American Society for Testing Materials.

(c) Specifications for Lap-Welded and Seamless Steel Boiler Tubes for Locomotives to be revised. The principal change in these specifications is revision of the tolerances for gage so that the tubes shall be not less than the thickness specified. Some changes were made in the physical test requirements to bring the specifications into harmony with those of the American Society for Testing Materials.

(d) Specifications for Rivet Steel and Rivets for Steam Boilers and other Pressure Vessels to be revised. The principal changes in these specifications are the inclusion of chemical requirements for rivets; the omission of tensile requirements for rivets; the addition of a table of permissible variations for bars.

(e) Specifications for Lined Journal Bearings to be revised. The number of compositions specified has been revised to one for both the back and the lining metal, and the compositions selected are those which are in most general use and which have been found to be satisfactory.

(f) Specifications for Engine Bolt Iron to be revised. The principal change made in these specifications is in the form and in the variation of tensile requirements with size of the bars.

(g) Specifications for Solid Staybolt Iron to be revised. The principal changes made in these specifications are in the form and wording of some sections and in the reduction of manganese permitted from 0.10 to 0.05 per cent.

(h) Specifications for Hollow Staybolt Iron to be revised. The principal changes in these specifications are the reduction in manganese permitted from 0.10 to 0.05 per cent; revision of the tensile test requirements to include elongation measured in 4 in., and yield point changed from 0.55 to 0.60 tensile strength; the addition of a splitting test and certain minor changes in form.

(i) Specifications for Tender Tank Hose to be revised. The principal changes in these specifications are in the form; and a small change in the physical requirements for tube and cover, and the friction; but there has been no change in the quality of hose required.

(j) Specifications for Bronze Bearings for Locomotives to be revised as follows: Section 2, Chemical Composition of Medium

Bronze, change Phosphorus from 0.2-0.6 to read 0.1-0.25. This change has been made because the present phosphorus specification is rather high for a so-called medium bronze, and the percentages given are more in line with common practice.

New Recommended Practice Specifications

(a) Specifications for Glasses for Reflex Type Water Gages. These specifications have been drawn up so as to require a high grade of glass and the committee requests that the members put these specifications into effect and let the association have the benefit of their experience.

(b) General Instructions on Standard Methods of Tests for Mechanical Rubber Goods.

- (c) Specifications for Wrapped Cold Water Hose.
- (d) Specifications for Wrapped Air Hose.
- (e) Specifications for Braided Air Hose.
- (f) Specifications for Fire Hose.
- (g) Specifications for Axle Light Belting.

The general instructions on Standard Methods of Tests for Mechanical Rubber Goods and the individual specifications for hose and for axle light belting have been prepared by a sub-committee working in co-operation with representatives of the Rubber Association of America; and the committee requests that the members put these specifications into effect and let the association have the benefit of their criticisms. Attention should be called to the fact that the individual specifications do not contain any methods of tests. All of these have been transferred to the general instructions. Only the required results are given in the individual specifications.

The committee recommends that the above revisions and new specifications be submitted to letter ballot of the association.

The report is signed by F. M. Waring (Chairman), engineer tests, Pennsylvania System; J. R. Onderdonk, engineer tests, Baltimore & Ohio; Frank Zelemy, engineer tests, Chicago, Burlington & Quincy; A. H. Fetters, mechanical engineer, Union Pacific; H. G. Burnham, engineer tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern Railway; J. H. Gibboney, chemist, Norfolk & Western; H. P. Hass, engineer tests, New York, New Haven & Hartford; T. D. Sedwick, engineer tests, Chicago, Rock Island & Pacific; G. N. Prentiss, engineer tests, Chicago, Milwaukee & St. Paul; G. E. Doke, engineer of materials and equipment tests, New York Central and H. D. Browne, engineer tests, Chicago & Northwestern.

Discussion

F. M. Waring (Penn.): The committee would like to call your particular attention to the proposed specifications for annealed carbon steel castings, which represent several years' work on the part of the committee in co-operation with the American Society for Testing Materials and the steel casting manufacturers. Your committee feels that these specifications represent the best that has been offered and recommends that the members of the Association put them into force for the purchase of steel castings at the earliest opportunity.

Under new specifications the committee recommends a specification for glasses for reflex type water gages. These specifications have been drawn up so as to require a high grade of glass and the committee requests that the members put them into effect and let it have the benefit of their experience.

There is just one amendment to the report as printed which the committee would like to make. In the specifications for steam heat hose, wrapped cold water hose, wrapped air hose and braided air hose appears the requirement to the effect that the ends of each length shall be uncapped and without fittings. The manufacturers have pointed out that some of them are making hose of that type, particularly steam hose with capped ends and therefore it would not be fair to discriminate against that type of hose. The committee gave this matter consideration and wishes to eliminate the sentence entirely from the four specifications in which it occurs.

Recommendations of the committee, then, are that the report as printed with the amendment just given be submitted to letter ballot of the Association.

J. H. Gibboney (N. & W.): Just one phase of the report that the chairman might have brought to your attention in a little more detail, and that is the demand within recent years for specifications for copper steel. The introduction and use of copper steel as an aid in rust resistance has made rapid strides within the last two or three years, and there have been about 40,000 all-steel cars constructed from that steel in the last two or three months. This has

been the result of some very comprehensive tests made by the American Society of Testing Materials by comparing copper steel with non-copper steel of substantially the same composition.

It is unnecessary to go into the details of that test. There was a demand for that class of material and the specification which the committee has provided in the galvanized specifications and the specifications for structural steel shapes, plates and bars permit the use of copper. They have not written a separate specification but have introduced the minimum copper content. I thought it might be well to call your attention to that fact, due to the desire of a number of the roads to use that class of materials for car roofing purposes and for construction of coal-carrying cars.

W. J. Bohan (N. P.): It is a well-recognized fact that the careful selection of materials and their judicious purchase in an open and competitive market is fundamental to and is reflected in efficient and economical railroad operation. All properly managed properties appreciate that well prepared specifications and tests for materials that fully meet, but which do not "overmeet" the requirements of the service intended for, and which do not impose unessential and expensive demands on manufacturers, are necessary in making such selection and purchase.

Efficiency is based upon common understanding and co-operation, and its attainment and maintenance are greatly assisted by written instructions that clearly set forth all the things desired. Efficiency depends upon the human equation and like the human being moves toward perfection by growth in knowledge and experience.

In going over the report I find under Recommendations, reference to four specifications as "Revised as shown and changed from Standard to Recommended Practice." It occurred to me as I read this clause that this might be an opportune time to mention a matter which has been long on my mind. It is my impression that the application of the word standard has been stretched too far. One definition given by the Standard Dictionary for the word "standard" is "A criterion of excellency." This I am sure is what the originators of the phrase "Standard Practice" had in mind in connection with railroad activities, materials and appliances. Is it not a fact, however, that the phrase has come to too largely convey the impression of something settled and closed for all time, instead of as the definition states "A criterion of excellency." Not perfect but in step with progress. A thing, which in order to maintain its excellency must be assiduously cultivated to prevent its becoming stagnant. We all know the human tendency to apply the brakes and move in well-worn grooves. Having this in mind I would like to offer in the interest of progress the suggestion that the phrase "Standard Practice" be changed to some other phrase, which better expresses activity. I will not attempt to suggest a phrase believing there are those in the Association that can do it better.

The gentlemen composing the Committee on Specifications and Tests for Materials are well known as authorities in their line and their names stand for efficiency and thoroughness. The Association is extremely fortunate in their selection and is to be congratulated. The report bespeaks excellency and value to railroad advancement and the unselfish and painstaking labor of its writers. I would, therefore, move that it be accepted without change, the committee be continued and extended a vote of thanks from the Association for its splendid work.

(This motion was seconded and carried.)



Built by American Locomotive Company for Use in the Philippine Islands

Shop Management Problems Are Discussed

Supervision Frequently Entirely Inadequate—Importance of Human Factor Emphasized

ALTHOUGH scheduled near the end of a heavy convention program—and in intense heat—the discussion on "Shop Management Problems of Today" proved to be exceptionally constructive and interesting.

By H. T. Bentley

Gen. Supt. of Motive Power, Chicago & Northwestern

Generally speaking, the subject can be discussed under the following headings: Men, management, materials, manufacturing, machinery, money and miscellaneous. Some of the problems in each group are comparatively easy to solve, whereas others are so interwoven with financial and similar matters that they require a careful analysis from various angles before definite action can be taken.

Men and Management

Labor turnover is one of our greatest problems today, serious disorganization results from men coming and going, particularly in industrial centers where the demand for labor is great, and whatever price is paid by manufacturers to secure needed help is added to the cost of their product, and in that way transmitted to the purchaser. With a railroad, having rates that cannot quickly be raised to furnish greater income, the employees look at outside rates paid on jobs, many of which are of a somewhat temporary character, and wonder why the railroad cannot pay the same rates. As a result there is a feeling of resentment, especially among the younger element who have little seniority to consider and who will lose nothing by making a change.

Stability of employment is something we should aim at, but due to fluctuations in business it is necessary to keep close watch of the income and expenditures to see that there is enough money to pay all expenses as they come due, which frequently results in a reduction in the payrolls with the disorganization due to men being laid off. This is a problem that unfortunately has frequently affected us all very seriously. When an organization has been built up after weeks or months of hard work getting it into shape, it is a serious blow to have it disrupted, and the loss cannot very well be put in dollars and cents. Where the railroad income or that of an individual does not net enough to put some away for a time of depression, the expenses must be reduced to meet the requirements.

The apprentice question is a problem that is very difficult of solution. At one time apprenticeships in railroad shops were sought by young men, and it was nothing unusual for the sons of a mechanic and their sons to take service with the same railroad as apprentices. Under present conditions the question of getting apprentices (who will be a credit to themselves and their families), especially for the boilermaking and blacksmith trades, is quite a serious one. In large cities no inducements appear to be sufficient to get young men to take a position that is honorable though dirty, but from the ranks of which a large number of men have graduated to some of the highest positions in the railroad world.

An efficient and wide-awake shop management is absolutely necessary to get results, and some of its problems are so interwoven with other things mentioned in this paper that its efforts can easily be offset by reason of shortage of material, use of machinery and tools that have long ago outlived their usefulness, and with little or no money available for their replacement.

The question of keeping shops clean and clear of scrap material is one that must be answered in one way or another, and where this work can be handled by a force of men under a competent foreman after the shops are closed, there is no interference with the men during working hours.

Don't Make Your Foreman into Clerks

It is most important but frequently difficult to know where men are working; whether they are on hand at the proper time for starting work; who is absent, and why? With some of the usual

timekeeping methods, the foreman is greatly handicapped in trying to keep track of his men, and I take the position that a foreman's place is out among his men and not doing timekeeping or clerical work in his office. As a result of findings by a committee belonging to all departments interested, a method of keeping time has been developed so that a foreman can quickly tell whether his men are on hand or absent, and the distribution of time made to the different accounts or engines worked on without the necessity of men or foremen doing any clerical work. This is a problem that has been solved with more general satisfaction than is usual in such cases.

The proper selection and training of men for positions of responsibility is still one of the real problems, particularly so for the reason that many mechanics do not appear to be anxious to accept promotion and added responsibility.

Handling Materials

One of the largest problems to deal with is the prompt furnishing and handling of material. The output of a shop can be boosted or seriously set back by the stores department. I am afraid that some of us do not give enough consideration to the proper handling of this important subject, and rather expect the stores department to be mind-readers as to changes in standards that the mechanical department may make. This in some cases necessitates the carrying of a new kind of material in large or small quantities or else there is a sudden heavy use of a stock material which formerly moved slowly, or the discontinuance of parts either due to a change in design or the disposing of equipment that formerly used such material.

One of the big problems of today is to get the material needed from the storehouse into the hands of the men who are actually going to use it, and at the least expense. In some cases the storehouse main building is so far from the place where material is to be used that considerable delay occurs, this being particularly true of standard material that is used daily, and in such a case small storerooms should be located at convenient places in or adjacent to the various shops so as to require little effort and time to get such material.

The handling of heavy material to and from the storehouse to the shops and to cars for shipment out on the road is a great problem. Whereas shop motor cars and overhead cranes facilitate movements, a locomotive crane for handling such material that cannot be conveniently reached by other means is a great asset around a busy shop yard.

Materials and Manufacturing

Too much usable material finds its way into the scrap pile and this necessitates a second handling. All material that can be reclaimed should be kept separated from scrap, and again, scrap material should be subdivided so that when it gets to the scrap dock for shipment and sale it does not have to be sorted again.

A few years ago with conditions and rates of pay then in effect, it was the practice among the larger railroads to manufacture practically everything needed for repairing and maintaining locomotives; among these parts being axles and all kinds of forgings, safety valves, injectors, and a hundred other things which according to the bookkeeping records used, indicated that a very large saving was effected as compared with prices submitted by the manufacturers of such articles. Under present-day conditions and rates of pay, it is questionable whether it is actually costing less to make articles in the comparatively small quantities used than to buy them from specialists who are obliged to cut costs in every direction so as to compete with firms who are handling the same lines. As one of our foremen aptly remarked when discussing this subject, "We do not know of any automobile user making the essential repair parts of a standard automobile, nor do we hear of a safety razor owner making the blades, although both of them might be in the machinery business."

To enable manufacturing to be carried on in an economical

manner either by outside firms or in railroad shops, a great degree of standardization is necessary in nuts, taps, dies and attachments to various devices furnished by outside firms so that it will pay manufacturers to specialize in certain parts and carry them in stock or distribute them to dealers in a manner similar to that adopted in the handling of automobile accessories.

Regularity of purchases will enable a manufacturer to keep a stock of standard parts and enable him to balance his work so that he will not have to make a set-up of a machine to handle a few pieces as is often done in railroad shops, and which of course adds to the cost per piece of the article being made.

Depreciation

The question of purchasing new machinery and tools is a pressing one, and because of financial conditions during the past few years has not had the attention that its importance warrants.

With the tremendous strides that have been made during the last two decades in high speed steel manufacture, with the resultant necessity of making the machines of sufficient strength to stand up under the speeds and feeds that the modern steels permit, it can be readily seen that machines designed and put into use 25 to 30 years ago cannot give the output that modern machines properly designed for present-day conditions will give. The result, in a number of cases, is that the work is not done as efficiently as it would be if up-to-date machines and methods were used.

With an investment of, say, \$1,000,000 worth of machinery that is depreciating and new machinery that is being improved to cut down costs, there certainly should be a fixed amount, say 5 to 8 per cent of the total investment, set aside each year for the replacement of those tools that are obsolete because of age, etc., but new machines costing thousands of dollars should not be bought unless it is known that there is sufficient work to be done at such a reduction in cost that, considering the first cost of the machine, depreciation, etc., it will pay a reasonable return on the investment.

We should not get rid of all tools or machines simply because they are not 100 per cent efficient under maximum requirements, but where new tools are purchased, the old shop tools should be assigned to suit the intermittent work in a roundhouse, if this can be satisfactorily arranged. If not they should be scrapped.

Money

In our efforts to solve the problems that confront us, we are sometimes able to see a way out of a certain difficulty if we can get an appropriation that may be used for new tools, machinery, cranes or other facilities for handling heavy material, and it is certainly very discouraging to be told that the money cannot be furnished, as the increased charges for material, labor, taxes, etc., have practically wiped out the amount needed by the mechanical department, and therefore the improvements so much needed cannot be provided.

Where it is possible to do so, I believe a fund should be set apart so that when small tools or machines are required to take care of some special condition that arises and for which no provision has been made in the budget, the superintendent of shops or master mechanic in charge should be able to get what is necessary, subject of course to the personal approval of the head of the department and properly accounted for at a cost of not to exceed say \$3,000. Nothing causes quite so much discouragement to an organization as to be in need of some small tool ranging in price from \$150 to perhaps \$1,000, and have to wait for a year to get it on the budget and perhaps longer than that before it is actually approved.

Miscellaneous

Where the size of a plant will permit, a shop doing the repair work should be independent of a roundhouse at the same point. In other words, where possible the roundhouse should, as a general proposition, have a machine shop so that ordinary machine work can be done without having to call on the back shop. It is very discouraging to the foreman trying to get material out for engines in the shop to have his work disorganized by having a hurry-up call from the roundhouse, which necessitates the removal of work from a machine so as to take care of the job needed for the roundhouse.

Much valuable time is lost in some shops due to lack of facilities for intercommunication, and as the expense of installing automatic

telephones between departments is not great this difficulty can be more readily taken care of than some other things involving large expenditures.

I have given you an outline of a few of the railroad problems, all of which we are trying, each in his own particular way, to correct or improve, and as the conditions vary in different parts of the country no hard and fast rules that can be laid down will be applicable to the various problems and others that confront us.

By D. J. Mullen

Superintendent of Motive Power, C. C. C. & St. L.

The shop management problems of today are too involved and too many to enumerate or describe fully, yet the successful solution of each is measured only by what it contributes to increased output or decreased costs, or a combination of both.

With this idea in mind this paper is not addressed to any of the specific problems of shop management which might involve a mechanical description or a statistical enumeration of performance or cost, but is directed to that broader question of shop management, which today is not developed in the railroad as in the industrial field.

The management of the industrial plant may anticipate for a long period in advance the nature and quantity of work that will be performed on any given unit. The locomotive repair shop differs materially on this point. It does not receive its raw material as does the industrial plant, for its raw material is a locomotive coming in for repairs, which in a greater or less degree furnishes its own material. Even this cannot be anticipated until the locomotive has actually arrived in the shop and entered upon its period of repairs. The condition is still further complicated because of the uncertain repairs to be given the various engines—in terms of labor and material.

Cost Accounting

Regardless of the effort that has been put forth in the development of new means and methods of performing work, or in the layout and arrangement of repair shops, it is a fundamental fact that no problem of management can be considered as successfully solved until it can be definitely established, by an accurate and comprehensive cost and product system that will stand analysis from every angle, that either the cost has been reduced because of a direct reduction in itself, or that it has been reduced because output has been increased.

In considering what is at hand in the way of shop cost accounting systems, one is impressed by the prevailing tendency of such systems to follow along and be productive of those reports required by federal regulations and corporate accounting rather than those that would be developed for purely mechanical analytical purposes by men fundamentally trained in mechanical administrations and not in that of accounting. How many railroad shops are there in the country where the management calling for the cost of manufacturing driving boxes for a certain type of engine can find these figures immediately available?

Such reports are not intended for analysis as to shop product or cost. They represent more what has been done than what is being done because of the consolidation of a large number of elements of cost into the general accounts. The segregation of the details making up these measured costs is not handled from the viewpoint of reflecting information as a barometer of cost and product. What is needed to remedy this condition is the introduction into the mechanical departments of what might be termed "engineering accounting," the purpose of which would be formulating and carrying on cost keeping representing the combination of auditing and engineering experience dictated primarily by those essentials necessary to the proper analysis of the current performance of the shop. This would mean not only keeping costs but using the data for analysis and engineering development for reducing costs.

Wages and Working Conditions

Intimately connected with the cost product system is the matter of wages and working conditions, and regardless of all the cost accounting methods that may be inaugurated or anticipated, the cost of performing any one unit of work can never be controlled until it can be pre-determined what the wages will be for performing that particular operation. It is in this one point alone that the successful solution of many problems of railroad shop

management are now held in indefinite suspense because the railroads are not supported by those agencies whose support is desirable in installing the methods of compensation and working conditions in which the cost performance of any one operation may be definitely established.

It has too long been the practice to view the operation of a locomotive shop as an expense. Were it viewed from the viewpoint of operation for profit as are all other industrial plants, the problem of railroad shop management of today would be backed up by a cost and product system, the equal of which could not be found in private industry. The problem of formulating such a system is far more complicated in railroad shop operation than it is in an industrial plant. The industrial plant is making a new product of a uniform nature, whether it is hairpins or automobiles; the point being that the first unit that goes out in the morning is no different from the last unit going out at night.

There are a large number of units of work performed in railroad shops which are identical, and with proper shop management would cost no more in one case than in another, providing the element of labor cost is so handled and developed that at least this large proportion of the total cost is a pre-determined fact before the work is commenced.

Constructive Analysis of Shop Operation

The constructive analysis of any cost accounting system would be along five general lines:

- Retirement, replacement, or changes in machinery.
- Development and installing new methods of performing work.
- Personnel organization.
- Methods of payment.
- Rules and working conditions.

In the final analysis of any problem coming under the five groups enumerated above it will eventually be a balance between the cost as it is, compared to the cost as it will be when the anticipated change is made.

Assuming the ideal condition is reached and the cost system developed, it would be necessary to consider to what unit of product this system would be compared; that is, will the accurate cost system be combined with the unit of output measuring a physical quantity of work, or expressed in a numerical unit of mechanical equipment, or as is commonly in vogue in this country, upon the product of the engine in the number of miles it has made before the engine is repaired.

It would seem that since shop operation is not responsible for miles that an engine makes, that it is not a problem of shop management. While it is true that the quality of work performed in a shop upon an engine to a great extent establishes the length of time the engine will remain in service, it must be recognized that the shop in repairing and sending an engine out to perform service, does not control the territory in which it operates, nor the facilities nor methods by which it is maintained while in service, and these are elements that should be taken into consideration in measuring shop output on a mileage basis.

Again the capacity or efficiency of a shop cannot be measured in its output by number of engines turned out. It may require in one month twice the work to turn out 25 engines that it does to turn out 50 in another month. A shop may be engaged in repairing engines requiring exceedingly heavy work, at which time its product in engines will be low, yet its efficiency may be just as great, if not greater, than when repairing a large number of engines with light miscellaneous repairs.

Establishing a Production Unit

There is a method by which miscellaneous output in the number of engines receiving various classes of repairs can all be equated to a common unit. Such a unit should fill the following conditions:

1. It should express in terms of the lightest repairs the amount of work required on a locomotive receiving the heaviest repairs.
2. The units so determined should be arrived at and expressed in terms of man-hours of labor.
3. The man-hours allowed should be established under conditions where the compensation or time for performing a given item of work is pre-determined.

In developing such a system it is essential that engines be repaired, subject to a classification of repairs of such specification that in allotting an engine to a certain class of repair a comprehensive description of the work is definitely determined by the class

of repair assigned. The next step is that of determining the number of man-hours required to perform the lowest class repairs. With this average man-hours required to complete the lowest class repair as a factor, the average man-hour required to complete the next highest class repairs is determined. The computation is made and the result of this determines the number of units that are to be assigned to the next highest class repairs.

For example: If a Class 5 repair requires 200 man-hours, it would be considered as one unit. If a Class 4 repair required 600 man-hours, it would be considered as three units, and so on up to the heaviest class repairs.

With such a system of analysis the number of man-hours per unit is directly indicative of the efficiency of the shop, in that as the man-hours per unit go up, the shop is less efficient than when man-hours go down.

In consideration of the quantity per unit depending upon how comprehensive the class of repairs may be, there will be a uniformity in the cost of repairs per unit, comparable with the fluctuation of the man-hours per unit. There will be reflected in increased and decreased cost per unit those economical conditions which require an increase or decrease in the wage scale. As shop facilities are changed for the better, it will again be reflected in the reduction in man-hours per unit. The application of such a system over a period of years may be traced in an increase or decrease in the man-hours per unit, the gain and loss in efficiency, due to the various conditions under which the shop is operated. There can be traced the average amount of work required to repair an engine as expressed in units per engine, and lastly, it is evidently an expression of the capacity of the shop as reflected by the number of units turned out per month.

It is through the presentation of such facts as would be derived from the accurate system of cost accounting and the application of a system of measuring output, that the management of the railroads could be induced to adopt those comprehensive policies of betterment and improvement in repair facilities which are so essential in keeping pace with the increased demand for repair shop output and reduction in cost of operation.

By T. W. Demarest

(Gen. S. M. P., Pennsylvania (Northwestern Region.)

It is with a very considerable amount of hesitation that I am endeavoring to carry on this discussion, particularly after the very able paper you have just listened to from Mr. Bentley. My hesitation is based also on the fact that the problems in shop management today are as large as the plant; they comprise your plant, your management, your supervision, your personnel and every item of your operation.

The entire situation can be divided possibly into two heads. One is the human factor and the other is the physical factor. Under the human factor I would place management, supervision, labor force and its maintenance, and the establishment of harmonious relations between the employees and the management. Under the physical factor I would place the plant, the machine tools, material, routing of work, and items of that kind.

The physical factor to me is the easiest part of the situation to meet because it can be met, as a rule, through the expenditure of capital, and as brought out by Mr. Markham, who addressed us the other day, our managing officers are realizing more clearly, that in order to get the benefit from the equipment and reinforce a failing labor supply the physical portion of the plant has got to be brought up to date.

Importance of Human Factor

The human side of your plant, however, is another situation entirely. In looking through one of the railway publications of recent date I notice the plans of a new shop which has just been built, and naturally I assume that in the construction of the plant—as it is a new plant—all of the labor-saving devices, all of the methods for shortening steps and saving dead labor, all of the machine tools and everything necessary to establish economical operation, had been incorporated. Reading through the article I noticed that the expected output from that shop was limited to one engine a pit a month. Now that struck me very forcibly, because with old plants with which I have been connected if I can't get two engines a pit a month, or sometimes two and one-half, I think there is something wrong in the shop operation.

I was curious as to why with a brand new plant only one engine a pit a month was expected; I could not reach any other conclusion but that the human factor was responsible. To me the

human factor is the important item, and I am going to try to give you a few thoughts concerning it from my own experience.

There are three radically different methods of handling labor. My first experience was with an absolutely open shop where the management could be just as arbitrary as it chose in the handling of its employees.

My next experience, which was not so long ago, by the way, was in the direct reverse, where it was the most arbitrary kind of a closed shop and where the men could tell the management what the management should do.

Under our present situation we are trying to develop a different method from either, and that method is neither an open nor a closed shop, but it is a plan under which the employees in the shops have with the management an equal voice in all matters pertaining to their welfare—I will touch on that later.

The Question of Supervision

The first essential in your human factor problem is your supervision. In the plan which I have just referred to, I found that we had sold the plan to the men but I was not at all sure we had sold it to the supervision, and in many cases we hadn't. In analyzing the situation I knew it was very evident we hadn't sold it to the supervision and we hadn't tried to; we hadn't taken the supervision into our confidence and we had not interpreted the policy of the management and did not put the men in the management where they could carry back to the men what the management was trying to do.

The most essential man in your shop today is your supervisor and according to the extent to which you have educated and trained your supervisor, so you may expect the men in the shop to react. Your contact man, who is your supervisor, represents to your workmen the attitude of the management. And you can't expect to have good relationship unless you have a good contact. That is your responsibility.

Another thing, your supervisor should be placed in a position where he feels he is an officer of the company and not a workman. He wants to be placed in a position where he is proud of his position and not simply perhaps feel that he is taking a job and increased responsibility with no adequate return.

Fifteen Men to a Foreman

He does not want to be overloaded with men, and one of the hardest things that we have to convince our management, as a rule, is the necessity for increased supervision. It is the cheapest investment I know of.

Not very long ago a president of a railroad who operates a very large car shop said to our vice-president that in the maintenance of their freight cars they had established an economy which could not be met in a contract shop and they were very proud of the performance. Our vice-president got me. He wanted to know what we were doing, and he said: "Investigate the situation and let me know what you find." We sent some men to study the plant. The first thing we found was that they were working on a piece-work or bonus system. The next thing we found was that the average number of workmen to a supervisor was 50. The next thing we found was that the supervisor was expected to keep the time, allocate the piece-work earnings, and allocate the use of the material, so they could keep an individual car record—and, gentlemen, he could not do it. The result was that insofar as they are concerned I told our vice-president that there was not a record at that particular plant that was worth the paper it was written on, and it was not the fault of the supervisors.

Our experience is that when men have to be educated—and they do—the education is a continual process; that where the work has to be kept up to the workmen, if you want results you have got to limit the number of men under a supervisor, and in my own experience that is about 15. That may sound rather low, but under your present labor situation, and you have all got it just as well as we have, under a situation when there is a decrease in rate of labor supply, a decreasing efficiency of labor, there is just one thing we have got to do: We have got to decrease the number of men reporting to a supervisor so that he can adequately follow their work, follow up the material, and their operations.

Keep in Touch With Foremen

After you have your supervisor educated the job is not done; you have got to have somebody whose business it is to keep in touch with your supervisory force; keep in touch with their men-

tal attitude and their mental processes. I do not know of any better way of doing this than perhaps the establishment of foremen's clubs,—where the foremen can meet one another, become mutually acquainted, exchange ideas, and meet their superior officers, and get from their superior officers direct the policy of the management. It has an enormous effect.

At one of our shops employing possibly 2,200 men, after the organization of the foremen's club, even although there were only about 65 men in the club, we found there were men in it who had worked in the same shop for years who did not know one another. I brought these men together. They had an opportunity of meeting socially with their families, an opportunity of exchanging ideas, and the co-ordination of the work between the departments was most materially improved just through the mutual acquaintanceship of the men.

Getting Down to Brass Tacks

To get down to the brass tacks of the situation—and that is the man on the floor of the shop, or the men operating the machines—it is certain that you can't expect good shop results if your men are limited or guided by men outside of your employ.

You can only expect results where your men, as employees without reference to outside influences, are willing to meet you and discuss their problems and yours across the table and do their bit in assisting the management to produce economical operation, just as they expect the management to do its bit in producing a fair return to the men.

I don't believe in the best day-work shop you ever saw you can expect the same economy in production, or the same output rate per unit, as you can in a shop where the more skillful men have the opportunity for making for themselves a higher rate of wages than the straight day-work provides. The necessity for conserving the labor supply, the necessity for building it up, absolutely compels some method of operation which will permit a man who desires to turn out a day's work.

The question of your labor supply is a vital one and its reinforcement and maintenance have got to be met in different ways. None of us can go out today and build up a plant "off the bat" by hiring skilled labor. The best way, of course, as far as it is practicable, is to relieve hand labor by machine labor, labor-saving appliances, relocation of machine tools, relocation of facilities to reduce the foot work to a minimum and produce economical results. You have got to resort to Mr. Purcell's method with which he has been very successful and the building up of your force through training of apprentices, but in my opinion that is not enough to maintain your departments.

There are at least three departments that no boy wants to enter as an apprentice. Those are the blacksmith shop, the boiler shop and the freight car shop. In these three departments it is not desirable to have a boy enter as an apprentice because the work is of a character which requires a mature man. Therefore you have got to have some other way of building up those three shops; the helper-apprentice system doesn't help you; a freight car shop on a four-year apprentice system is nonsense. Our men agree with us on that. It is pretty hard to tell a man freight car repairing is not a trade and if you can't make a freight car repairman in three to six months, you don't want the man around your plant; but your regulation don't permit you to do it.

Stabilizing Employment

Now back of this is something else that is vital and that is out of your control except as you may be able to inform your executive managing offices—that is a budget which will permit you to operate your plant on a uniform basis. There isn't anything that so hampers production as the necessity for relieving men that you have spent money in training, who go out of the shop because the management tells you the road isn't making money and you will have to reduce expenses. There is another phase of the problem. When business is good the equipment is behind and when it is poor you can't repair it. If you can convince your management as to the economy and advisability of operating your shop on an even number of hours throughout the year without respect to the business, you will do a great deal in accomplishing all these results we are talking about; if you can't do it you will not get the results you are after.

Other Discussion

Mr. Davis (Wabash): We were asked about six months ago to find the cost of overhauling a certain number of locomotives.

If we had been assigned a force of 50 men to do this work and the time of year had been favorable, it would have been an easy matter. In the average shop, however, there is so little in the way of excess capacity to go on that it is impossible to do extra work without an additional force. We analyzed the situation and found that there were a great many discrepancies between the output of different railroad shops. We found a common difference of output of $2\frac{1}{2}$ times per man-hour unit between shops where piece-work was used as compared to day-work.

Nine Vital Factors

We analyzed the different factors involved in output, and I will touch on them lightly: Timekeeping, cost-keeping, specialization, routing work through shop, incentives, standardization, improved shop processes and practices, industrial relations.

Nearly all these have been covered in what has been said here with the exception of timekeeping and a little bit on cost-keeping. Timekeeping should set out how much the man should be paid for the time which he puts in. In efficient shop management and the employment of labor the primary essential is a time keeping system. There are a good many ways of doing this, from accepting a man's own word, to an elaborate time-keeping system where a man is checked by some clock process for every operation which he performs. The first is terrifically expensive, and the second just as expensive. There is a happy medium between these two methods by which through some mechanical process—whether it be a time clock or not—a check can be had on the man every noon, every afternoon, and every night at least, and in addition you can have the opportunity of seeing him.

The measurement of a man's time can easily be done by putting in some mechanical process—either a clock or some other mechanical process.

The next factor is to see that the company is repaid in work for the money which has been expended. This function of time-keeping gathers together a group of men who are commonly called non-essential in a shop, or non-productive labor, and gives us the facts, the very thing we must have to go on further with cost-keeping. That is usually neglected.

Now, under that system, in checking men to find out what they

did do, it is necessary to have some sort of a form. On that form you should first of all divide the shops into classes, and finally divide it down to a point where the next element of timekeeping—or cost-keeping—can be injected.

In order to have a good cost-keeping system, the first thing is to report the basic facts; the second is to analyze those basic facts, classify them, and have them prepared to use in your future work.

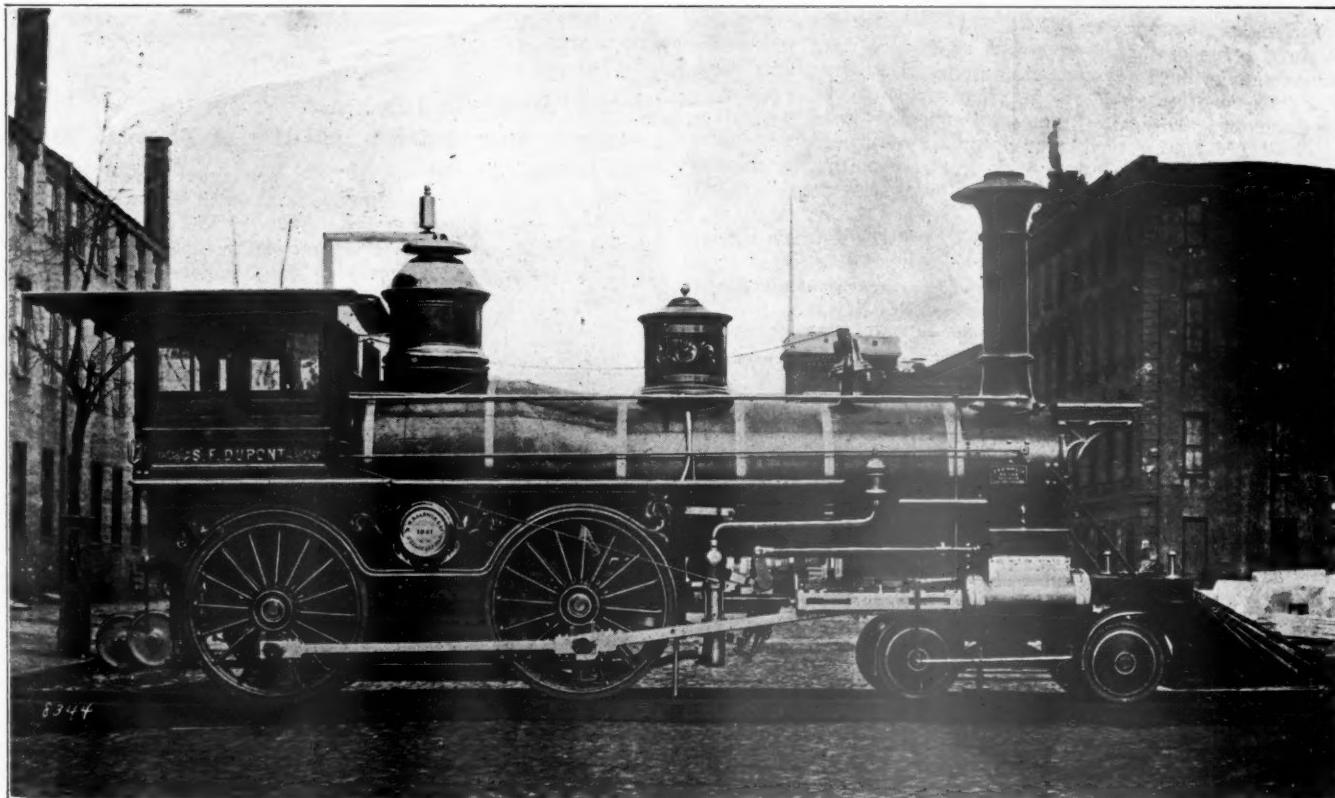
Now, the simple inexpensive way of doing this thing is the best, just as it is when you get into the simple and effective way of timekeeping. Cost-keeping runs hand in hand. In a cost-keeping system you find out what each item costs you and you are able to judge whether or not you can improve on the process.

The railroad wants to know what each thing costs so it can buy properly. Second, so it can tie it in with the R. E. accounts; and third so it can improve its shop processes.

I have mentioned incentive. A man does in proportion to what his incentive is, and without that incentive the maximum effort is not going to be made. The very best incentive that I know of is more wages. Now, whether it is a piece-work plan or a bonus plan does not make any difference, but whenever you have arrived at that incentive, whatever it is going to be, make it adequate, make it certain; let it be so that the man can see it directly in front of him, and let its method be simple and not an elaborate system in which the man will have to guess at what he is going to get.

When we know just when, just how and just where everything was done and what it cost us, then we will have an answer for that political—well, what shall I call him?—that uses the railroad for a football.

THE GAINESVILLE & NORTHWESTERN RAILROAD of Georgia, the track of which, according to inspections made by the State Public Service Commission, is in bad condition, was ordered by the commission on June 14 to discontinue passenger train service for 30 days, and within that time to make needed repairs to track and roadbed.



The Latest Word in Freight and Passenger Power on the Philadelphia, Wilmington & Baltimore (Pennsylvania) in 1862

Increasing Efficiency of Modern Locomotives

Changes Suggested in Various Details of Design—Part Played by Operating Department

BALTASAR MARTINEZ, representing the National Railways of Mexico and operated lines, read the following paper describing a new device that is being applied to Mexican locomotives.

Draft Regulator and Low Degree Superheater

Under the subject of "Increased Locomotive Efficiency" I wish to offer remarks in reference to a combined draft distributing deflector and low degree steam superheater, which has been tried out and is being applied generally to the locomotives on the National Railways of Mexico and Operated Lines.

Since the advent of the locomotive as a power unit, one of the principal problems has been the question of proper drafting and distribution of heat to the entire heating surfaces of the firebox and flues. The maximum capacity of a locomotive can only be obtained through perfect combustion in the firebox and by the total and uniform utilization of heating surfaces, together with a proper circulation of water in the boiler.

With the standard Master Mechanics and other draft appliances commonly in use, the center and lower boiler tubes burn out and require renewal sooner than the balance of the tubes and the center and lower parts of the flue sheets show the effect of excessive temperature more than any of the lateral or upper parts of the flue sheets or of the flues in the corresponding parts of sheets. Therefore, it can plainly be seen that the greater portion of the gases passing at a very high temperature from the firebox have followed the path of least resistance, that is, through a triangular section of the flues with the base at the bottom of the flue sheet leading up to, or near the center of the sheet. Due to the fact that the exhaust jet is centrally located in the smokebox and that the area of the point of suction is a great deal less than the grate area of the firebox, it follows that the tendency of the gases or products of combustion is to be drawn through the triangular flue section referred to.

The device we are using is a hollow plate practically corresponding to the dimensions of the periphery row of flues, and placed transversely in the smokebox and parallel to the front flue sheet, at a distance of from 3 to 4 in. from it, thereby retarding to a certain extent the flow of gases through the center section of flues and at the same time creating an increased use of the outer and upper flues, which has the effect of spreading the fire and causing the flames to uniformly heat not only the crown sheet but the side sheets as well.

As a proof of this statement, after one and a half year's service in the smokebox of an oil-burner locomotive, the device was removed and it was found that the impinging of the sand against the plate had created an equal erosion opposite each flue.

By these means we accomplish the utilization of the entire heating surfaces of the firebox and flues, with a consequent and natural increase in the thermal efficiency of the boiler and a better combustion over the entire grate surfaces, resulting from an even and more constant pull over the fire surface; besides, operation of locomotives equipped with this device demonstrates that the fire burns evenly over the entire grate surface, and that as a result there is considerable economy obtained in fuel.

In addition to a more complete distribution of draft, the deflector plate being a hollow one, either part or all of the steam may pass through it, thus delivering to the cylinders a steam of fairly dry quality which may be termed a low degree of superheated steam. Practice has proven that there is sufficient heat taken up by the steam while passing through this device to about offset any tendency to condensation during the period of expansion in the cylinder.

The drying out of steam or low degree superheating is accomplished by allowing the steam to pass through the plate, which maintains a high temperature owing to the impinging and friction of the hot gases as they are expelled from the tubes.

As previously stated, the combined heat distributing deflector and low degree steam superheater was thoroughly tested during

18 months, four years ago, by the National Railways of Mexico. At the present time there are 150 locomotives, both oil and coal burners, equipped with this device and it has been decided that the remaining locomotives should be so equipped.

The general results obtained with the use of this device are as follows: (1) a 13 per cent fuel economy when burning oil; (2) a 15 per cent fuel economy when burning coal; (3) a reduction of 9 per cent in water consumption; (4) a very noticeable decrease in staybolt breakage; (5) a substantial decrease in engine failures due to leakage of flues; (6) the temperature of steam in the cylinders of the locomotive increases 32 deg. F. above the corresponding steam temperature at 200 lb. boiler pressure; (7) a proper and sufficient draft can be obtained through the flues and around the periphery of the deflector plate, with an increased nozzle opening of approximately 3 per cent; (8) no difficulty is experienced in keeping dry pipe and steam pipe joints tight, as this particular construction provides sufficient flexibility to permit expansion and contraction without setting up undue strains at dry pipe and steam pipe joints; (9) one noticeable feature in connection with this device is that there has not been any trouble experienced with flues becoming stopped up. This is explained by the fact that all of the flues are uniformly working.

We have demonstrated to our own satisfaction that the engines are easily lubricated and such lubrication is maintained as easily as in the case of the saturated steam locomotive.

No special oil is required for the lubrication of locomotives equipped with this device, and no difficulty has been experienced as to packing or valves blowing.

There are many other salient points in connection with this device, such as reduction in running and enginehouse repairs, conservation of cylinder and piston packing, etc., all of which have convinced us of the high sustained over-all efficiency of locomotives equipped with this device. I will not attempt to cover these points in detail, as we believe it would be easier and more satisfactory for you to send your own representatives down, who will see for themselves and testify to my statements.

Lighter Weight and Increased Power from Special Steels and Use of Three Cylinders

A. H. FETTERS (U. P.): We sometimes forget that the efficiency of the modern locomotive is as much a matter of proper operating conditions as of design. However well a locomotive may be designed we must realize in practice the operating efficiencies by taking advantage of the many daily factors that go toward wasting or conserving locomotive fuel and locomotive service hours. When full advantage is taken of these factors the ultimate economy is reached.

The mere addition to a locomotive of a number of well recognized economical devices does not necessarily produce economy in ultimate operation, but the well planned and scientific application of certain of these devices, based upon their reaction to specific operating conditions, will produce the economies sought.

The last ten years have been marked by a pronounced effort toward increasing the thermal efficiency of the locomotive, as noted by the adoption of the superheater, feed water heater, exhaust steam injector, brick arch, siphon, etc.

Other devices contemplate improvement of mechanical operation, including many well designed specialties of earned recognized merit, and others that have not yet been proven. In contemplating the addition of these economy producing devices to a given design, we should try to strike a balance, so far as possible, between fuel and operating economies thus produced, and the extra maintenance and time out of service, which the addition of a large number of these devices is liable to entail. A 25 per cent saving in fuel is only a saving during the time the locomotive is in actual operation. A well designed conventional type of locomotive without economy producing adjuncts will earn a better reputation

on the road than a poorly designed locomotive with plenty of economy accessories.

It is possibly true that the modern locomotive design has reached a point where further progress will be slow and laborious—there are, however, some further possibilities, particularly in the matter of improving the horse-power weight ratio. It is possible that lighter designs will be built in the future, without in any way impairing the strength, by taking advantage of better materials and improved ideas. At present there is undoubtedly an opportunity for eliminating a part of the weight of the heavy conventional design of locomotive frame, which is uneconomical for two reasons; first, on account of the poor stress distribution of metal; second, on account of large sections in cast steel working out poorly in foundry practice. Cylinders are also too heavy and should be designed more frequently in cast steel, with proper wearing bushings.

In the future I believe that staybolts will be made of high-grade alloy steels, having a tensile strength two or three times that of the present iron staybolts, with as good or superior fatigue properties. This seems possible, particularly in view of the large introduction of flexible staybolts.

We have not yet reached the ultimate limit in the reduction of reciprocating weights made possible by the use of still better materials.

In the last few years the metallurgist has presented the locomotive designer with a valuable heritage in highly improved steels, bearing alloys, etc., in which the designer is not always permitted to invest for his employer, who unfortunately so frequently sees only the first cost, and not the dividends. Limitations in this direction are deplorable and tend to stunt real progress.

We should abandon the practice of buying locomotives like we buy a pair of shoes—ready-made. If we can design a fair locomotive in four months and one good one in six months, we can design a better one in a year or more, and the dividends on the extra time involved will be large.

The modern trend toward longer locomotive runs calls for the use of the best materials that science can produce, coupled with a new effort by the designer to incorporate a real stamina, as the locomotive of tomorrow will be called upon to run a modern marathon in place of the 100-yard dash of our past experience in locomotive runs.

Acknowledging that the modern locomotive has about reached the available limitation of individual axle load, and that little further can be expected in this direction or in the increase in number of axles available for traction, it would appear that any improvement that could be made in the conventional adhesion factor of four to one would give the designer a new hold upon the problem of how to build a more powerful locomotive within the present weight limitation.

As the present adhesion ratio of the two-cylinder locomotive is definitely fixed within narrow limitations, it is my belief that the possibilities of the three-cylinder simple locomotive will soon be exploited. The adoption of a third cylinder makes it possible safely to reduce the factor of adhesion to 3.5 or less, whereby a proportionate amount of tractive force can be developed without increasing the present axle load.

It is my thought that a carefully proportioned three-cylinder simple locomotive with its uniform torque and increased starting effort is worthy of a great deal of study in connection with the problem of starting and handling our excessively heavy modern passenger trains.

Operating Department May

Secure Locomotive Efficiency

W. L. Robinson (B. & O.): It is generally understood that proper maintenance, particularly of fuel and capacity increasing devices, is essential for efficient operation, and it is further generally recognized that adequate locomotive terminals and facilities for promptly caring for existing power is necessary. It is understood that many terminals are undergoing re-arrangement of layouts and re-designed facilities for inspection, coaling and cleaning of fires. The efficient operation of the best designed and most modern locomotives is dependent upon such handling at the terminals as will insure flues being properly cleaned, superheater elements functioning properly, smokebox air leaks eliminated, etc. The installation of proper methods of cleaning out carbon from the exhaust passages of cylinders is worthy of consideration. Cases have come under observation where an engine

was not performing satisfactorily, but when exhaust passages were cleared of carbon, the operation was equal to what it was when the engine was received from the builders.

Assuming that the mechanical maintenance and handling forces are approaching an efficient basis, attention is directed to features commonly classed as belonging to the transportation or operating department, which if given proper consideration further promote efficiency, among which may be mentioned the following:

- Determination of greatest gross ton-mileage per hour of crew time or proper tonnage rating and maintenance of highest economical train load.

- Necessary competent road supervision for instruction of engine crews as to what is expected of them to get the most out of improved design and proven fuel and capacity increasing devices.

- Disbursement of a continuous uniform quality of fuel. Some coal is too good for railroad use, some not good enough; however, it is preferable to have uniformity in order that the crew may know definitely what to expect.

- Encouragement and insistence on engineers definitely determining the cause of locomotives not efficiently operating and reporting the irregularities or defects correctly.

- Serious study of local conditions to determine by what methods increased miles per day may be obtained from locomotives. On a large railroad, one territory may obtain good results by extending the runs over more than one division, another territory by assignment of locomotives to regular crews and another by the extension of the turn-around system.

- Scheduling of freight trains, thereby permitting roundhouse forces to anticipate when locomotives have to be available.

- Proper classification and dispatching of trains, making them up so they require little or no switching at congested points, thereby reducing yard delays and permitting of increased amount of "main-tracking," as well as longer runs of locomotives. A study of the instructions regarding "System, Divisional and Through Classification of Freight Service," in effect on the B. & O., prepared by E. T. Horn, chief of yard and terminal operation, cover what has generally proven beneficial.

- Increased attention to the cost of operation of the various types and classes of locomotives in order that the total cost of operation of the various classes can be determined. The cost of fuel and wages generally runs over 50 per cent of the cost of operation and at present many roads made studies of fuel and wage cost, but are handicapped through inability to obtain the maintenance cost by types or classes of locomotives.

- Satisfactory water supply in order to reduce the necessity at shop terminals for delays incident to frequent boiler washing, repairing boiler leaks, etc.

The last thought that I had in mind was expressed in a most effective manner by Mr. Storey yesterday in his talk, that was with relation to bringing about a better understanding between the various departments.

I have had considerable experience in some of the various departments and I think that the average mechanical man—I mean in the minor class to which I belong—should better understand the transportation officer and that the transportation officer—the minor ones I am speaking of—should better understand the mechanical officer. I think that is one of the best ways of increasing efficiency on the modern locomotives, a better understanding between the roundhouse foreman and the yard-master and those people down to and below the rank of superintendent.

General Comments

C. A. Soley: I hesitate to take issue with my friend, Fettlers, but there is one point in his paper about which I would like to raise a warning, that is regarding steel staybolts. A friend of mine some years ago, in charge of a road, a subsidiary of the Steel Corporation, said to me, "Why can't we use steel for staybolts?"

I said, "There is a very good reason and, as proof of that reason, there is not a steel staybolt in any locomotive in the United States that I know of."

"Well," he said, "look at the improvement there has been in steel in the last few years. You can tie steel in a double bow knot and do all of these things that you could not do formerly, and that is what you need in a staybolt."

I said, "Try it and let me know what the results are."

I did not see the man for some time, but another representative saw this man within a few weeks and he said, "I will take off my hat to Mr. Selye. I got some chrome-alloy steel, the finest I could get at Pittsburgh; you could do everything with it in a laboratory. I made it into staybolts and put it into the boiler, but it didn't last a week."

Another western road some years ago thought it would try steel for staybolts and got some soft steel and put it in. It lasted a while and then it commenced to break, but the unfortunate feature of the breakage was the fact that the bolts broke in bunches. You are all aware of the breakage of steel axles, crank pins and other parts and doubtless have noticed the rather fresh break that sometimes made you wonder what sort of a blow or push or twist or strain could be put on fresh material to do that. It is a characteristic of steel to break in a curious fashion, on account of its homogeneity. Staybolt iron on the contrary is built up. As a result you get your fracture time when you don't know much about it, and that is when you are firing up, when your firebox is full of smoke, when you can't observe the action of the staybolt, and that is the time that it gets a little check.

That starts the progressive fracture and final failure of the staybolt. There are certain things you can do to lessen the breakage of staybolts by design. It is not necessary to go into that in this connection, but as regards the use of steel, permit me to make at least the warning, "Try it if you like."

It is a fact that steel is permitted for staybolts in the marine service of the United States. I have talked with the General in Washington and he admitted it and said he was sorry, but he couldn't help it. He also said that any engineer having trouble with steel staybolts in a marine boiler generally stops the trouble by putting in an iron one.

Another point I would like to bring up is efficiency; whether it is real or whether it is only apparent. In that connection, the remarks of Mr. Aishton with reference to getting acquainted with all the accounting methods were very pertinent. The cost of all these things, in the final analysis, is what counts, and we want to get the proper distribution of all the costs in making tests of new devices or materials that are on the road, of different classes of locomotives against one another, etc.

I was struck with the application of that idea on the discussion of the stoker. It is true that the stoker will permit the use of an inferior fuel and has rather encouraged the use of an inferior fuel. Why shouldn't it? What is the ultimate cost? There is the true measure.

We do things on a railroad in rather a rough fashion. Very often we have been computing these results in ton-miles. What does a ton-mile mean? You multiply the number of tons by the

number of miles and you get ton-miles, but in making a test on a locomotive, particularly on a freight run, you are not taking into account the more important factor, that is, the question of time. An engine may take twice the hours that another engine takes in going over the road, but you get the same ton-miles.

As an instance of that, recently a test was made on the N. C. & St. L., a syphon-equipped engine produced a result in ton-miles of a saving of 10.7 lb. of fuel, but in addition to that there was a time saving of 6.55 per cent. Now, there was something worth while. The operating officers of that road think more of that time saved than they do of the coal, and it occurred to me to combine those two expressions into one of saving, "ton-mile-hours," and I got a result of 16½ per cent. The question of time is an element in costs on a railroad, whatever you do.

In this connection I would refer you to a recent discussion in the New York Railroad Club where Col. Emerson, of the U. S. A., gave a very pertinent discussion of ton-mile-hours, or elapsed time, in reference to the real cost of relative operations.

GRAFTON GREENOUGH (Baldwin Locomotive Works): The thing which affects the efficiency of a locomotive is its ability to grow. It has two limitations. One of these may be termed financial and the other physical. The financial limitations are those that can be removed. Those things have been discussed. They are discussed on every road. They are discussed with almost every order for locomotives which is placed. Those are the things that can be removed. The physical limitations of the tunnels, the gage of track, the quality of the road, its ability to stand a load, those are the things which are ultimately going to be the limiting factor as to what we are able to do with the locomotive until they are removed.

Now the strange, paradoxical aspect of this situation is that those very limitations up to the present time are the things which have made it necessary, irrespective of financial cost or convenience to bring the locomotive to the state of economical efficiency which it now enjoys. For instance, if we had had roadbeds of infinite stability it would not have been necessary to go into the matter of counterbalancing and the use of higher grade steels for moving parts so that the dynamic augment would be reduced to a minimum. Had it not been for the limitations in height and width it would not have been necessary for us to use the superheater and various other devices to get all that is possible out of a boiler in a limited space of time.

The one thought that I wish to leave with you is that we should try to overcome the financial difficulties so that we would plan for the future instead of the present. The time is coming when we will have seriously to consider what is to be done to get more room in which to put the tremendous units of power which we are now making and developing.



Locomotives Ready for Shipment, Eddystone Plant, Baldwin Locomotive Works

Report of the Committee on Tank Cars

Investigation of Proposed Designs of Bottom Outlet Valve —Other Changes in Construction Considered

THIS COMMITTEE during the past year has given consideration to various detailed devices which tend toward the improvement of tank cars; a number of such devices having been submitted to the committee for approval.

Safety Valve

In view of the results obtained from safety valve tests, as covered in previous reports of this committee, it was decided to appoint a sub-committee to work in conjunction with a similar committee of the American Petroleum Institute.

This sub-committee will prepare gages for existing valves with a view of securing greater accuracy in the construction and maintenance of these valves so as to avoid leakage at low pressures. The sub-committee will also consider safety valves of new design which may be submitted to the association, and will give special consideration to a safety valve using a frangible disc in order to overcome the leakage of low pressure.

This sub-committee will also give consideration to safety valves for Class V chlorine tank cars, with a view toward standardization of the bolting flange.

Bottom Outlet Valve

The sub-committee appointed to investigate this subject has secured valuable data in connection with valves of various designs submitted to them for trial service. The report of the sub-committee states, in part, as follows:

"Up to March 1, 1923, 35 designs were considered by the committee, of which 20 are modifications of the present plunger type, 11 are designs of the plug type, two are the rotary disc type, one a combination of valve and outlet cap, and one a new design of bottom outlet chamber, above which any type of valve may be used.

Of the 36 ideas considered by the committee 27 have been approved for service trial.

Of these 27 nine have been abandoned on account of having proved unsatisfactory under service trials.

Of the 27 ideas approved for trial 6 have not been heard from since their installation, or have neglected to report to the sub-committee. However, general claims of satisfactory performance have been made by the designers of several of these valves.

Of the 27 ideas approved for trial, 3 have not been installed on tank cars for service trials.

Of the 27 ideas approved for trial 2, one for outlet valve chamber and one for outlet cap combined with a valve, are still undergoing trial, although neither of them is intended to solve the problem of a tight bottom outlet valve, and so far no definite reports of performance have been submitted to the sub-committee.

The remaining seven valves are still undergoing trial and reports of performance are being submitted regularly on the sub-committee's standard form of questionnaire. Out of these seven valves, Nos. 2, 7, 17 and 22, show signs of being equal, if not superior to the ordinary valve now in use. Valve No. 8 has given fairly good results, but is quite complicated. Numbers 13 and 18 have not made a satisfactory showing, although still undergoing trial. It is a question whether further trial should be allowed."

The sub-committee's detailed report is attached as an appendix.

In order to make an intelligent comparison of the valves under test as compared with the existing standard outlet valve, the sub-committee was instructed to compare the performance of valves under test with present standard valves on an equal number of cars. This comparison to be made by two tank car companies, (Union Tank Car Co. and Texas Company) each company to make test of 15 valves.

Dome Closing Arrangement

Circular No. D. V.-274 has been issued on account of a misprint in the first paragraph of Section 7 (d) of the Specifications for Class III Tank Cars, as revised in 1922, to include "New cars."

Several designs of the bolted type cover have been submitted to

the committee by various tank car builders, and in a majority of cases, the design has been approved after certain modifications were made.

It appears to the committee that certain fundamentals could be established by them in connection with this type of dome cover and it has, therefore, been arranged for the sub-committee on safety valves to also undertake the study of various types of dome closing arrangements with a view of standardizing certain features. The committee appointed by the American Petroleum Institute is to co-operate in this matter.

Failure of Heads of Tanks

There have been reported a number of cases of failures of heads on tanks originally anchored by head blocks but afterwards transferred to steel underframes and center anchorage applied, those failures being traceable to damage from impact on the head blocks.

This matter has been referred to the Arbitration Committee, which recommends that a circular be issued by the Committee on Tank Cars, calling attention to the importance of seeing that cars with heads damaged by impact are returned to the owners for application of reinforced shoes as required by the specifications. Circular No. 299 has been issued covering this matter.

Tests of Tanks of Class IV Tank Cars

It is recommended that Paragraph 23, Page 35, covering Specifications for Tank Cars be revised to the extent that the test period for Class IV tank cars should be made the same as for Class III tank cars.

Flashing Openings in Dome

Casing Class IV Tank Cars

The Bureau of Explosives called the committee's attention to Section 7, (a) of the Tank Car Specifications for Class IV Tank Cars which provides that—"Openings through the lagging shall be flashed around projections to prevent admission of water." This does not specifically state that the tops of the domes must be so constructed that liquid cannot enter between the dome wall and outer shell. On account of numerous accidents due to the absorption by the lagging material of gasoline, thus giving off a dangerous vapor, the committee recommends that the specifications be changed accordingly.

Special Marking on Multiple Unit Tank Cars

The question was brought up by a shipper of multiple unit tank cars making regular shipments of liquid chlorine in drums, whether or not these cars shall bear some marks of identification which will indicate that the design of the car has been approved by the Tank Car Committee.

As shipments of this character are now covered by Interstate Commerce Commission regulations, the transportation of this material in drums is under the jurisdiction of the Bureau of Explosives, which passes upon certain constructive features of these cars. The Tank Car Committee has tabled this subject until some decision is made by the Interstate Commerce Commission.

Adjusting Safety Valves on Tank Cars

Specifications for tank cars standard, revised 1920, specify that safety valves on tank cars adjusted to 25 lb., a tolerance of 3 lb. above and below the specified pressure, is allowed. This means that valves opening at 22 lb. or 28 lb. do not require adjusting.

Owners of tank cars are not receiving any benefit from this specified tolerance, because billing repair cards do not specify at what pressure the valves opened, nor is any reason given why it was necessary to adjust the valves. The committee, therefore, recommends that the Arbitration Committee add a requirement to Interchange Rule No. 9 to show the pressure at which the safety valve opens to justify the charge for adjusting.

The following changes are recommended in the Tank Car Specifications:

Safety Valve Plug, shown in Fig. 9-A, should indicate a groove at the end of the thread in order to facilitate the threading. The bottom of the 1 in. cored recess should be provided with a fillet so as not to weaken the plug at the clearance groove.

Under paragraph 2-B, specifications for rivets for Class III tank cars, should be revised to read the same as paragraph 2-B under specifications for Class IV tank cars. It is recommended that the drainage hole in the safety valve housing be raised $\frac{1}{8}$ in., making the dimension from the top of the housing to the center line of the drainage hole 2-5/16 in. instead of 2-7/16 in. in order to lessen the probability of drilling the drainage hole through and into the housing proper.

Appendix to Report of Committee on Tank Cars

Report of Sub-Committee on Bottom Discharge Outlets

(In the appendix the sub-committee presented a list of all the bottom discharge outlets submitted for trial. The ones shown below are those which the sub-committee reports are equal or superior to the standard design. Of the others referred to No. 8 is the Carr Valve, No. 13 the Dodge Valve and No. 18 the Garrett Valve. Editor).

No. 2. Positive Self-Locking Valve, designed by the American Car & Foundry Company, 165 Broadway, New York, N. Y., plunger type, employing the use of special outlet valve casting. The valve mechanism is all in the bottom of the tank, which is attached to the bottom discharge casting by a tapered thread joint. This permits removal of the mechanism for replacement or repairs without disturbing the outlet casting. This valve was installed on T. C. X. 177 about March 2, 1922, and, together with another valve of the same type recently installed on T. C. X. 3026, has made a total of 21 trips under load, reports of which show only two cases of sticking and two cases of leakage. Leakage was at the rate of but 50 to 150 drops per minute. The last report on this valve was dated February 13, 1923. No objectionable features have been reported, and the general opinion is that the valve is easy to operate. There is practically no difference in time required for unloading through this valve as compared with the ordinary plunger type in general use.

No. 7. Carll Valve, designed by A. B. Carll, assistant engineer, Gulf Refining Company, Pittsburgh, Pa., double seated plunger type with seat on outlet chamber which screws into outlet flange. Installed September 15, 1921, on two cars, G. R. C. X.

2864 and G. R. C. X. 2865, which are used for transportation of kerosene and gasoline. Eleven trips under load have been reported, two of which show slight leakage. The latest report received covering the performance of this valve is dated June 15, 1922, at which time Mr. Carll advised that on account of one of these cars having been involved in a wreck, two new bottom outlet flanges were being made of cast steel and will be used to replace the two cast iron flanges with which these cars are equipped. The matter of further reports of performance of these valves has been taken up with Mr. Carll.

No. 17. Everlasting Valve, designed by the Everlasting Valve Company, 2 Rector street, New York, N. Y., sliding disc type. Installed on T. C. X. 2906, used in the gasoline service. Reports of 27 trips under load have been received, six of which show slight leakage. Trials extend over a period of about three years. The valve has been shopped three times for repairs. Practically all reports comment favorably on the way this valve functions. One of the reported leakages was supposed to have been caused by corrosion, but as the valve made a successful trip without further attention or repairs immediately following this reported leakage, corrosion was evidently not the cause. Two of the leakages were reported by the inventor of another valve, which is also under trial.

No. 22. Merco-Nordstrom Valve, designed by the Merrill Company, Chicago and San Francisco, plug type. Valve self-lubricating. Complete unit attached to outlet flange. This valve has been installed on tank cars G. A. T. X. 6198 and 6187, used in the gasoline service. Fifteen trips under load have been reported, two of which show slight leakage of from 15 to 35 drops per minute. No sticking of the valve reported, but in two cases the valve showed stiffness. One of the leaks reported was due to the valve not being entirely closed. Closing the valve stopped the leak.

The report is signed by C. E. Chambers (Chairman), superintendent motive power and equipment, Central Railroad of New Jersey; C. T. Ripley, chief mechanical engineer, Atchison, Topeka and Santa Fe; Geo. McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania System; Col. B. W. Dunn, chief inspector, Bureau of Explosives; A. E. Smith, vice-president, Union Tank Car Company; Geo. Hartley, Hydro Asphalt Products Company, and C. W. Owsley, superintendent, railway traffic and sales department, The Texas Company.

Discussion

R. L. Kleine (Penn.): *I move the report be accepted and the recommendations be submitted to letter ballot.*

(The motion was seconded and carried.)



Baggage Car of Special Shrine Train from Tacoma, Wash., to Washington, D. C., Advertising Tacoma as "the Lumber Capital of America"

Report of the Committee on Wheels

Revision of Specifications for Chilled Iron and Wrought Steel Wheels Proposed—New Gage for Steel Wheels

In 1917 the new arch plate 700 lb. design for cast iron wheels for use under cars of 80,000 lb. capacity was made recommended practice. In 1920 the new design of wheels of weights 650, 750 and 850 lb. were made recommended practice. No change has been made in the specifications to provide tests proper for these wheels. Furthermore, investigations of failed wheels have indicated that the chemistry of the wheel has a bearing on its serviceability, therefore, a demand has arisen for a chemical clause in the specifications. Your committee has prepared a new cast iron wheel specification to take care of these new features, and also to clear up certain clauses, which have been subject to criticism because of being indefinite. A meeting was held with representatives of the Association of Manufacturers of Chilled Iron Wheels, at which they were given an opportunity to criticise the proposed specifications. We wish to acknowledge the assistance and support, which these representatives gave. The final specifications, as proposed, are as shown below:

Proposed Specifications for Cast Iron Wheels

[As far as possible the important changes in the specifications and Code of Rules are shown in italics.]

1. SCOPE.—These specifications cover all 33 in. cast iron wheels for railway service, for loads of maximum gross weights not exceeding 95,000, 132,000, 169,000 and 210,000 lb. based on units of eight (8) wheels.

Manufacture

2. MATERIAL.—(a) Wheels shall be made of a mixture of such composition, that with good foundry practice and proper annealing, they will have the required chill in the tread and meet the following requirements:

FRACTURE.—(b) The fracture shall show a soft clean grey iron free from defects such as holes containing slag or dirt more than $\frac{1}{4}$ in. in diameter or cluster of such holes, honeycombing the hub; white iron in the plates or hub; or clear white iron around anchors and chaplets at a greater distance than $\frac{1}{4}$ in. in any direction. Steel chaplets are preferable to iron chaplets.

CHILL.—(c) The depth of clear white iron shall not exceed $\frac{7}{16}$ in. at the throat and 1 in. at the center line of tread and must not be less than $\frac{1}{2}$ in. at the center line of tread and $\frac{7}{16}$ in. at the throat. These limits apply to all weights of wheels. The blending of clear white iron with the grey behind it shall be without any distinct line of demarcation, and the iron shall not have a mottled appearance in any part of the wheel at a greater distance than $1\frac{1}{4}$ in. from the throat and the tread. The depth of clear white iron shall not vary more than $\frac{1}{4}$ in. around the tread in any one plane in the same wheel.

Chemical Composition and Tests

3. CHEMICAL COMPOSITION.—(a) The wheels shall conform to the following requirements as to chemical composition.

Combined carbon, maximum, 0.90 per cent.

Sulphur, maximum—0.17 per cent for 1923 to 1924 incl.

0.16 per cent for 1925 to 1926 incl.

0.15 per cent for 1927 to 1928 incl.

0.14 per cent for 1929 and after.

Manganese, minimum, 0.50 per cent.

Total carbon desired, minimum 3.35 per cent.

Phosphorus desired, maximum, .35 per cent.

Analysis shall be made by manufacturers from test blocks poured during the day's melt from each cupola from which wheels purchased to these specifications are poured, to determine the percentage of manganese, phosphorus, sulphur and silicon. The determination of carbon shall also be furnished merely for information. A copy of this analysis shall be given purchaser or his representative on request.

CHECK ANALYSIS.—(b) An analysis shall be made by the pur-

chaser from one of the test wheels representing each 100 wheels. The chemical composition thus determined shall conform to the requirements specified in Section 3-a.

Drillings for analysis shall be taken from a drill hole bored into the back double plate of the wheel midway between the core holes.

4. PATTERNS.—(a) Patterns and chillers must be such that they will produce wheels according to dimensions shown in A. R. A. drawings for wheels.

DIMENSIONS.—(b) The normal diameter of the wheels produced by the chiller must be A. R. A. Standard 33 in. measured at a point $2\frac{5}{8}$ in. from the outside of tread of the wheel. Wheels shall not vary more than $5/16$ in. above or below the normal size measured on the circumference. Each wheel shall be so nearly circular that a true metallic ring placed on its tread, and bearing somewhere on the cone, shall, at no point, be more than $1/32$ in. from the tread. The thickness of the flange shall be within the maximum and the minimum flange thickness gages adopted by the A. R. A. for new wheels. The flange thickness on any individual wheel must not vary more than $1/16$ in., the thickness to be measured at a point $\frac{5}{8}$ in. above base line of tread.

TAPING.—(c) All wheels shall be taping by the manufacturer with A. R. A. standard tape. The normal wheel having a circumference of 103.67 in. shall be designated as Tape 3 wheel, limited by $1/16$ in. over and under the normal circumference. The smallest diameter of wheel acceptable under the specifications will be designated as Tape 1 wheel, the largest diameter acceptable under the specifications as Tape 5 wheel. Each tape size will cover a range of $\frac{1}{8}$ in. in circumference. The wheels will be made with five small lugs cast on the hub. When taping the wheel a sufficient number of these lugs are to be cut off allowing the proper number to remain to represent the tape size. Under no circumstances are any of these lugs to be cut off after the wheel is received from the foundry. These instructions are for new wheels coming from the foundry.

WEIGHTS.—(d) Wheels shall be in accordance with the weights shown in Table I, based on 1917-1920 A. R. A. Drawings.

[Standard sizes of cores have been added to Table I.—EDITOR.]

CORES.—In cases of wheels ordered with cores smaller in diameter than the standard, the additional weight should be considered as an addition to the normal weight and paid for by the purchaser.

Physical Properties and Tests

5. TEST SPECIMENS.—(a) When ready for inspection, the wheels shall be arranged in groups, all wheels of the same date grouped together and for each 102 wheels which pass inspection and are ready for shipment, 2 wheels furnished free of cost shall be taken for test. One of these shall be the highest tape wheel and shall be subjected to drop test; the other which will be the lowest tape shall be subjected to the thermal test. If the inspector

TABLE II

Weight of wheel, pounds	Weight of tup, pounds	Height of drop, feet	No. of blows
650	250	9	12
700	250	10½	12
750	250	12	12
850	250	13	12

of the railway company so desires, he may make his drop test on a low tape wheel and demand a third test wheel of the highest tape size to be broken up to determine the chill; this third wheel also to be furnished free of cost.

DROP TEST.—(b) The anvil of the drop testing machine shall be supported on rubble masonry on a concrete foundation at least 2 ft. deep and shall weigh not less than 1,700 lb. The striking face of the tup shall be 9 in. in diameter and flat. When bottom of the face of the tup assumes a round or conical form by wear it shall be replaced. The face of each of the three bosses sup-

porting the wheel under test shall be flat and measure 5 in. in width.

(c) The test wheel shall be so placed on the three supports with the flange down, that the tug will strike centrally on the hub. The test wheel shall pass the requirements given in Table II without breaking in two or more pieces. If the test wheel fails all wheels bearing the same tape size shall be rejected.

(d) If test wheel cracks with three blows or less it will be considered as having failed.

6. CHILL TEST.—(a) The wheel selected for drop test and the wheel which has been given the thermal test shall be broken so that the chill may be examined in at least four different portions of the wheel. The depth of pure white iron shall conform with the requirements in Section 2-c. If the sample does not conform to the requirements stated all wheels of the tape size represented by the sample shall be rejected.

7. THERMAL TEST.—(a) In making the thermal test, the wheel shall be laid with the flange downward in the sand with the channelway 4 in. deep and width as shown in Table III, molded in green sand around the wheel, the tread of the wheel to form one side of the channelway, and the clean flange forming as much of the bottom as its width will cover. This channelway shall be filled with molten cast iron which shall be hot enough when poured, so that the ring cast, when the metal is cold, will be solid and free from wrinkles. The time when pouring ceases shall be noted, and after the time given in Table III has elapsed, an examination of the wheel shall be made. If a crack develops in the wheel within the time limit specified in Table III, all wheels bearing the same tape size shall be rejected.

TABLE III		
Weight of wheel, pounds	Cooling time, minutes	Width of channelway, inches
650	2	1 1/4
700	2	1 1/4
750	2	2
850	2	2

(b) In order to prevent spitting while pouring, the tread and flange may be covered with a coat of shellac. Wheels selected for test which are wet or which have been exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances shall the thermal test be applied to a wheel that in any part feels warm to the hand. Thermal wheels shall be broken so as to determine the chill and not the fracture.

Additional Tests

8. DROP AND THERMAL TESTS.—If the test wheel fails in either drop or thermal tests all wheels bearing the same tape size shall be rejected. The remaining wheels of the lot shall be tested as a new lot of wheels.

Workmanship and Finish

9. WORKMANSHIP.—(a) Chill shall have an inside profile that, in the finished wheel, will produce the exact form of flange and tread contour as shown by A. R. A. drawings adopted in 1917 and 1920.

FINISH.—(b) All wheels shall be thoroughly cleaned by removing all core sand and foreign substances. Wheels offered for inspection shall not be covered with any substance which will hide defects. The body of the wheel shall be smooth and free from slag, shrinkage or blow holes, swollen rims or other defects. The hubs and rims shall be solid. The tread and throat shall be smooth and free from deep and irregular wrinkles, slag, sand wash, or chill cracks and sweat. The hub core shall not be more than 1/16 in. out of center.

Marking

10. MARKING.—All wheels shall be marked and numbered consecutively in accordance with instructions issued by the purchaser.

All wheels shall bear the initials of the purchaser, wheel number, weight of wheel, month, day and year when made and for indicating the tape number, five small lugs 3/8 in. in diameter and 3/16 in. high to be cast on the inside of the wheel.

All wheels shall have the name of the manufacturer and place cast on the outside plate of the wheels.

Wheel numbers once rejected shall remain unfilled.

Wheels conforming to requirements of these specifications shall have plainly marked on the outside plate A. R. A. 1920, for wheels of nominal weight of 650 lb. and 750 lb. and A. R. A. 1917 for wheels of nominal weight of 700 lb. and 850 lb.

Inspection and Rejection

11. INSPECTION.—(a) The manufacturer shall notify the pur-

chaser when ready for shipment, and shall furnish all the necessary facilities and labor to enable the inspector to make test and proper shipment of the wheels. The inspector shall have free access to parts of the manufacturer's works which concern the manufacture of all wheels ordered, or at any time while the work is being performed.

REJECTION LIMITS.—(b) If any lot of wheels submitted for test fails to meet the requirements of drop, chill, fracture, thermal or chemical test as regards combined carbon contents, all wheels of the same tape size shall be rejected.

(c) Any lot of wheels which fails to meet chemical requirements, all wheels of that lot shall be rejected, except as regards the combined carbon content, which condition is covered in paragraph 11-(b).

INDIVIDUAL REJECTION.—(d) Individual wheels will be considered to have failed and will not be accepted or further considered which:

(d-1) Do not conform to standard measurements, special consideration being given to dimensions of rim and hub and contour plates and location of hub core.

(d-2) Are over or under weight; overweight will be accepted if no overweight is charged for.

(d-3) Have physical defects described in paragraphs 4-2 and 4-b.

(d-4) Do not bore out readily due to hard hub or hard spots.

(d-5) In all cases where wheels are rejected, the letter "R" must be chipped out of the legend A. R. A. unless such wheels meet the requirements as to chill, thermal, drop and chemical tests, set forth in these specifications.

REJECTION AT DESTINATION.—(e) Wheels which show injurious defects while being finished by the purchaser, or which crack while being pressed on axle, shall be rejected provided the axle pressure is not excessive and the bore of the wheel shows no evidence of faulty machine work for gouging.

12. REHEARING.—Samples for chemical analysis which represent rejected material shall be preserved for fourteen days from date of test report, in case of dissatisfaction with the results of the test, the manufacturer may make claim for rehearing within that time.

Cast Iron Wheel Design

In 1917 the 700-lb. wheel was made recommended practice. This wheel differs from the old design in that it was the arch-plate type and had 25 lb. additional metal. In 1920 the arch-plate design of weights 650, 750 and 850 lb. were also made recommended practice. Your committee feels that these wheels have now been in service long enough to demonstrate their merit and that they should therefore be advanced to recommended practice, with the exception of the 850-lb. wheels. There are few of the latter in service and sufficient data has not been accumulated to warrant this design being advanced to standard practice. At present there are a number of private car lines and railroads who are still applying the old type light weight wheel. It is not fair in interchange to have these wheels put under cars, as the committee feels they are not safe for mountain grade service. If the designs are advanced to standard practice, a rule can be included in the code of rules which will prohibit the use of light weight wheels in interchange after a certain date. We recommend that the following rule be placed in the code of rules:

If cast iron wheels, other than A. R. A. Standard 650, 700 and 750 lb. are applied, this should be considered as wrong repairs after July 1, 1924. If the date of casting shown on the wheel is later than July 1, 1924, the owning line may bill for improper repairs. It is understood that wheels having different tread contours and flange sizes greater than those shown in standard drawing will not be included under the class of improper wheels.

The reason for excluding the tread contour and the flange dimensions is, that this subject is still open for discussion by the committee and a number of roads are using special tapers and also special reinforced flange, which in no way affect the safety of the wheel.

Taper of Tread of Wheels

At the request of the American Railway Engineering Association, the committee held a joint meeting with the sub-committee of this association on Track Stresses, at which there was a full discussion of tread design of wheels and its relation to the canting of rail. It developed there was little data available in regard to the effect of small or large tapers on wheel tread, so far as the effect on the rail was concerned. The representatives of the A.

R. E. A. brought out the fact that the spreading of rails and the wearing into tie plates and ties on the outside is a serious problem and on many of the roads they are meeting this by the canting of rails. Some of their representatives have felt that the wheel tread should have a lighter taper than 1 in 20 to help relieve this condition. It was brought out that wheels and rails both wear quickly after being put into service and any relation between the tread contour and the contour of the rail was soon lost. Thus it would not appear likely that making a slight alteration in the taper would remove this condition, and furthermore, the main cause of the spreading of the rail was entirely independent of tread taper.

The sub-committee of the A. R. E. A. asked for a statement as to the possibility of a change in the taper of the wheel, in order that they might have a permanent basis from which to start recommendations for canting rails. Your committee advised them that they had not received any data that would warrant making a change in the taper. The present taper is thought to be most advantageous, as regards flange wear. The last change made in the taper was in 1907, when it was changed to 1 in 20 from 1 in 25. At present practically all wheels made in the United States are being made with this standard taper. Your committee advised the sub-committee of the A. R. E. A. that they did have under consideration the making of the tread with a single taper in 1 in 20 instead of the present double tread, and this procedure met with the approval of the sub-committee of the A. R. E. A.

Grinding Cast Iron Wheels

The committee was requested to give consideration to the question of grinding new cast iron wheels. Studies were made to determine the actual amount of eccentricity found in new wheels after mounting. This eccentricity is of course due to two conditions: First, eccentricity in casting; second, eccentricity in mounting. Members who are grinding slid flat cast iron wheels report, that they frequently find a high spot at a distance from the slid flat spot, which would indicate that the high spot helped to produce the sliding, due to catching on the brake shoe. They also report that the wheels which have been ground give much better riding effect than ordinary new wheels, which would also indicate that the average new wheels have considerable eccentricity. Measurements of new wheels have shown eccentricities as high as 3/16 in., though the average is much below this. One large road in the southeast is grinding new cast iron wheels and they report that this practice has proven a desirable one and has resulted in better wheel service. Investigation indicates that in modern machines, it is possible to grind new cast iron wheels for approximately 60 cents a pair.

The committee feels there is a possibility of better results by grinding mounted new cast iron wheels and it therefore recommends that where roads have facilities they give consideration to this practice.

Seams in Cast Iron Wheels

A communication was received regarding the weakness of present Rule 72, regarding condemning limit for seams calling attention to the fact that a seam, whenever found, should cause the condemning of the wheel, regardless of its length, because of the fact that the seam is often covered over with good metal and it is impossible to determine its extent. The actual presence of a seam is a great hazard, and the majority of broken flanges are due to this defect. The committee agrees with this criticism and suggests that it be changed to read:

Any circumferential seam within 3 1/4 in. limit from flange.

The present rule allows an inspector to pass a wheel having a seam 2 1/8 in. long and located close to the 1/2 in. limit from the flange, which the committee feels is dangerous practice.

Flange Thickness for Cast Steel Wheels

A request was received from the manufacturers of cast steel wheels, that the flange thickness limitations be reduced to the same as those for wrought steel and steel tired wheels, instead of the cast iron wheel limit. The manufacturers presented a series of tests which indicated that the strength of the flanges was in excess of that of the cast iron wheel. The committee had a representative make a test of flanges worn down to the two limits and these tests indicated that the strength of the flange of the cast steel wheel was much greater than that of the cast iron wheel and equal to that of the wrought steel wheel. Under these circumstances, we feel that the claim for a lower scrapping limit on flanges of cast steel wheels is a justifiable one and there-

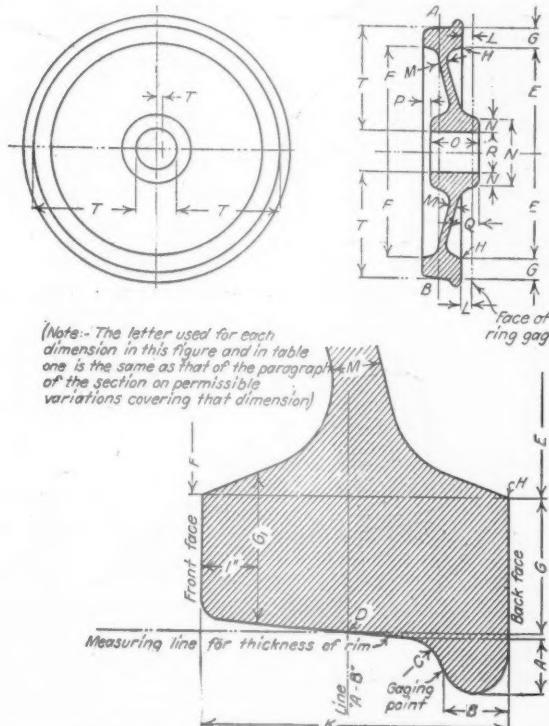
fore, recommend that the limit be made 15/16 in. for all cast steel wheels under both freight and passenger cars and that changes in the Code of Rules be made accordingly.

Condemning Limit for Steel Wheels

At the 1922 convention the Wheel Committee recommended rolled steel wheels be allowed to wear 1/4 in. lower than the present limit under tenders of switching locomotives. The committee now feels that such a test would not produce reliable figures for many years, as a great many of the roads use cast iron wheels under tenders. The present scrapping limit for rolled steel wheels under freight cars is entirely too high in comparison with the scrapping limits of the steel tired wheels; the steel wheel limit is 1/4 in. higher than that for steel tires, through the critical line from the throat to the underside of the rim. This appears unjustifiable, as the tire is more liable to breakage due to its fastening to the center than is the rolled steel wheel. Experiments made to determine the strength of the flange of the wheel when worn to the present limit and to 1/4 in. below the present limit indicate that the flange with the 1/4 in. lower limit has a strength greatly in excess of that of the cast iron wheel and should be entirely satisfactory for freight service. The committee therefore recommends that the condemning limit for rolled steel wheels in freight service be reduced 1/4 in. and the limit for locomotive tenders and passenger cars be left as now shown in the Standard. After the passenger car and the locomotive tender wheels have worn down to their limit, they can be transferred to freight car service and an extra 1/4 in. of service secured. The practice will result in a saving of large sums, as there are now millions of rolled steel wheels in service in this country. The committee recommends changes in the Code of Rules in another portion of this report, which will cover this change in scrapping limits.

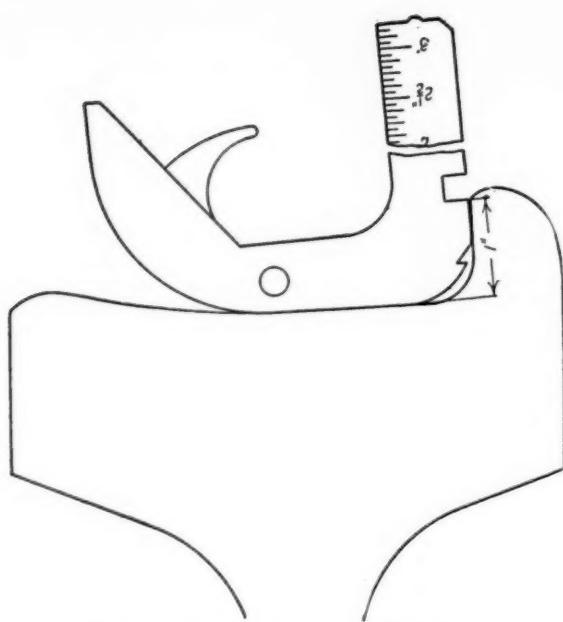
Proposed Specifications for Steel Wheels

The committee has written complete new specifications covering wrought steel wheels. The old specifications contained a number of clauses which have resulted in confusion and argument in inspection at wheel plants. Furthermore, some of the tolerances

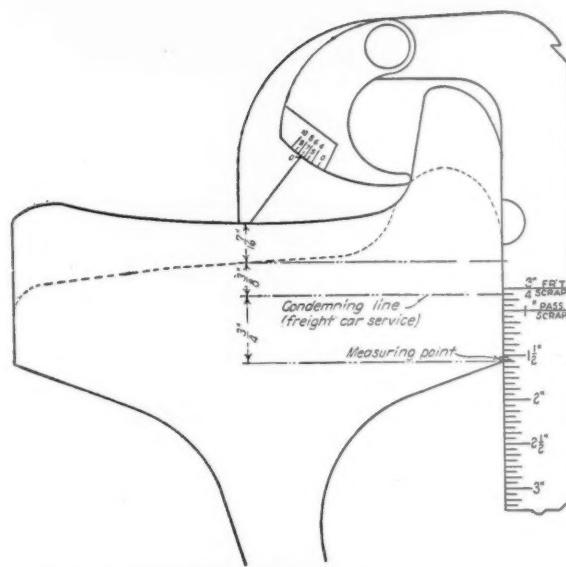


General Dimension Referred to in Table I, Page 1633

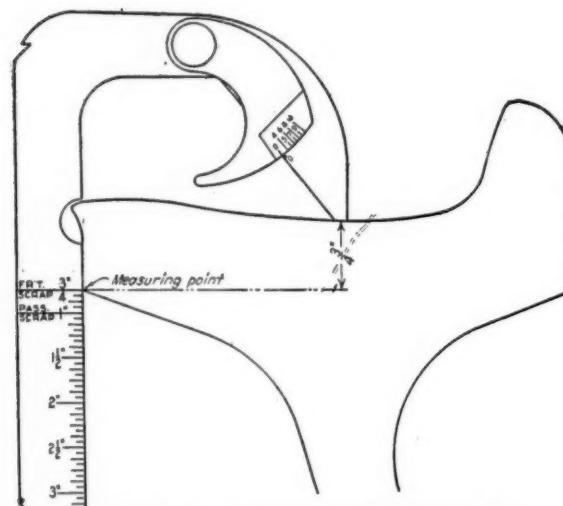
were not practical. The committee held a joint meeting with representatives of the steel wheel manufacturers and each member of the committee visited the plant of a manufacturer, in order to be thoroughly familiar with the details of the manufacture.



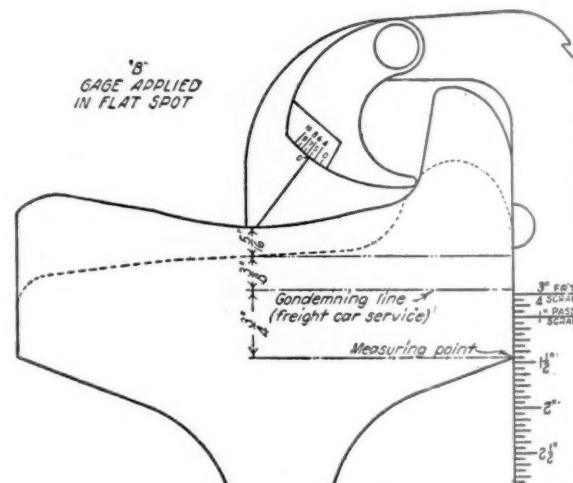
METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE VERTICAL FLANGES UNDER RULE 74



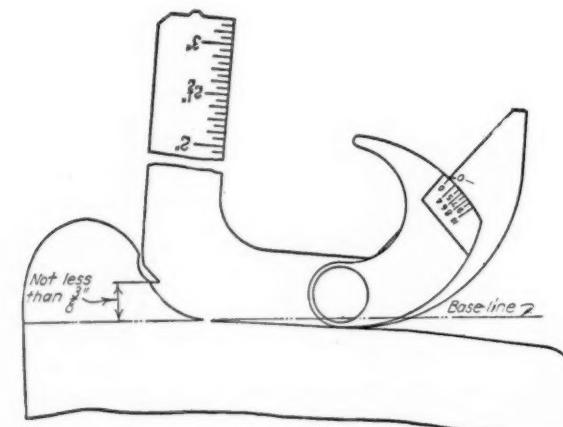
METHOD OF APPLYING STEEL WHEEL GAGE ON WORN FLANGE WHEEL. THE POINTER INDICATES AMOUNT OF METAL IN SIXTEENTHS OF AN INCH TO BE TURNED OFF TREAD TO RESTORE FLANGE CONTOUR WITH WITNESS GROOVE. THE SIDE SCALE SHOWS AMOUNT OF METAL ON TREAD ABOVE MEASURING LINE.



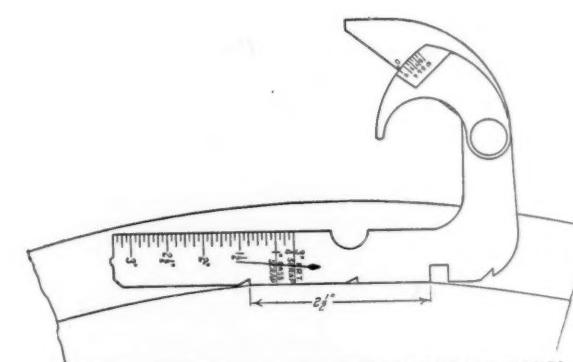
ALTERNATIVE METHOD OF APPLYING STEEL WHEEL GAGE TO WHEELS WHILE UNDER CAR TO DETERMINE WHETHER THEY ARE TO SCRAP LIMIT OF TREAD THICKNESS. WHEN WHEELS ARE REMOVED FINAL CHECK MUST BE MADE ON FLANGE SIDE OF RIM.



'8" GAGE APPLIED IN FLAT SPOT
METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE AMOUNT OF METAL TO BE TURNED OFF TREAD TO REMOVE FLAT SPOT AND ALSO EXTRA METAL TO BE TURNED OFF TO RESTORE FLANGE CONTOUR.
IN THIS ILLUSTRATION ONE EIGHT OF AN INCH PLUS ONE SIXTEENTH OF AN INCH OF TREAD METAL SHOULD BE CHARGED TO DELIVERING LINE ACCOUNT FLAT SPOT AND ONE QUARTER OF AN INCH CHARGED AGAINST OWNING LINE ACCOUNT RESTORING FLANGE CONTOUR. THE EXTRA ONE SIXTEENTH OF AN INCH CHARGED FOR THE FLAT SPOT IS MADE TO ALLOW FOR CUTTING UNDER HARD SURFACE AT FLAT SPOT.



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK LOCATION OF WITNESS GROOVE IN FLANGE.



METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE SOLID FLAT SPOTS AND SHELL SPOTS. RULES 69 & 71.

Uses of Gage Described on Page 1634

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shall

The committee therefore, submits the specifications shown to replace the present specifications:

1. SCOPE.—These specifications cover all solid wrought carbon steel wheels for locomotives and cars.

I. Manufacture

2. PROCESS.—The steel shall be made by the open hearth or electric process.

II. Chemical Properties and Tests

3. CHEMICAL COMPOSITION.—The steel shall conform to the following requirements as to chemical composition.

Carbon	0.65 to 0.85 per cent
Manganese	0.60 to 0.85 per cent
Silicon, not less than.....	0.15 per cent
Phosphorus, not over.....	0.05 per cent
Sulphur, not over.....	0.05 per cent

4. LADLE ANALYSES.—To determine whether the material conforms to the requirements specified in Section 3, an analysis shall be made by the manufacturer from a test ingot taken dur-

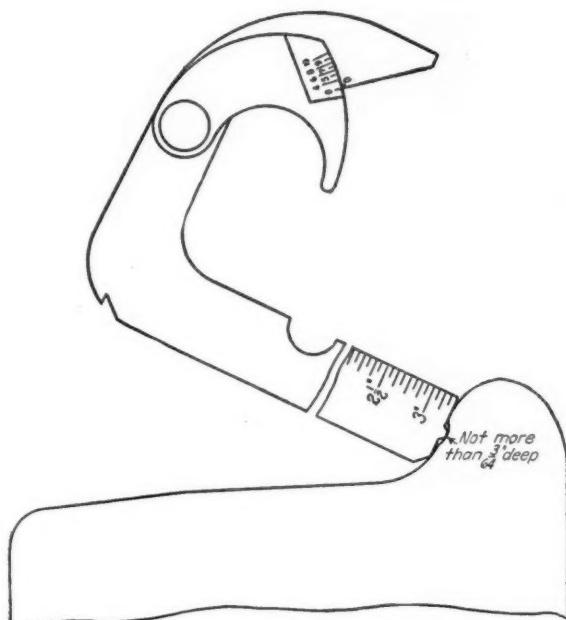
ing the pouring of each melt. A copy of this analysis shall be given to the purchaser or his representative.

5. CHECK ANALYSES.—A check analysis may be made by the purchaser from a wheel selected by him, representing each melt, and this analysis shall conform to the requirements specified in Section 3. A sample for check analysis may be hot punched or taken by means of a core drill from any one point in the plate, or two samples may be taken, in which case they shall be on radii at right angles to each other. Samples shall not be taken in such a way as to impair the usefulness of the wheel. Drillings for check analysis shall be taken by pouring entirely through the sample, parallel to the axis of the wheel; they shall be clean and free from scale, oil and other foreign substances. All drillings from any one wheel shall be thoroughly mixed together.

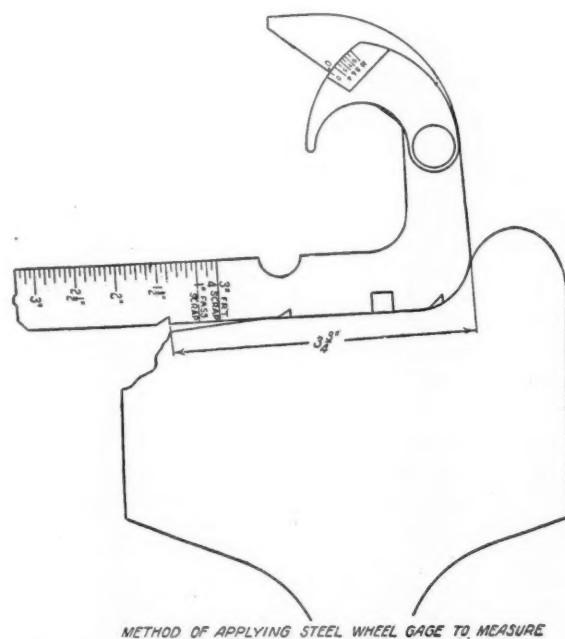
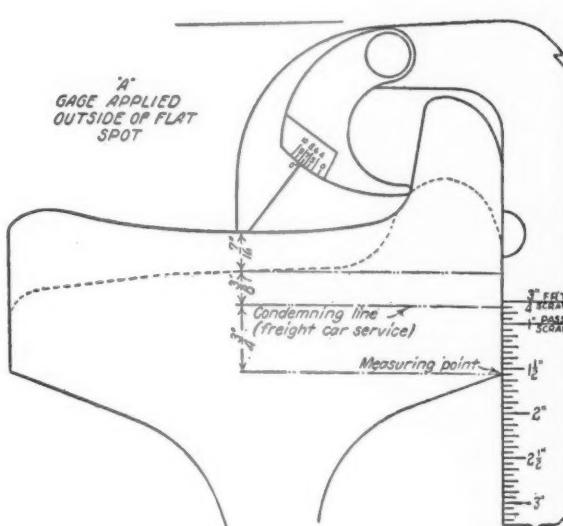
III. Mating

6. MATING.—(a) Wheels must be mated as to tape size and shipped in pairs.

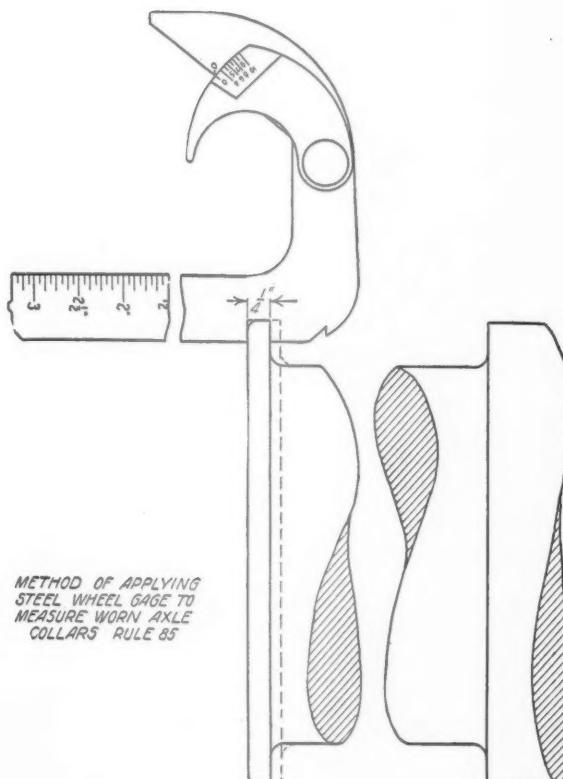
(b) When specified all wheels of any one type and rough bore



METHOD OF APPLYING STEEL WHEEL GAGE TO CHECK DEPTH OF WITNESS GROOVE IN FLANGE.



METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE LOCATION OF CHIPPED RIMS. RULE 78



METHOD OF APPLYING STEEL WHEEL GAGE TO MEASURE WORN AXLE COLLARS. RULE 85

shipped in any one carload lot shall be so selected as to permit mating and mounting within a five-point carbon range according to the carbon content stamped on the wheels; i.e., 65-70, 66-71, 67-72, 68-73, 69-74, 70-75, inclusive, etc., the preferred ranges to be considered as 70-75 and 75-80.

IV. Tolerances

7. TOLERANCES.—Wheels shall be furnished rough-bored, and with faced hubs, and with contour of tread and flange as shown on Standard Drawing, A. R. A. Manual, Section "D" Page —, and shall conform to the dimensions specified subject to the following tolerances:

Flange

(a) HEIGHT OF FLANGE.—The height of flange shall not be less than 1 in. nor more than $1\frac{1}{8}$ in.

(b) THICKNESS OF FLANGE.—The thickness of flange shall

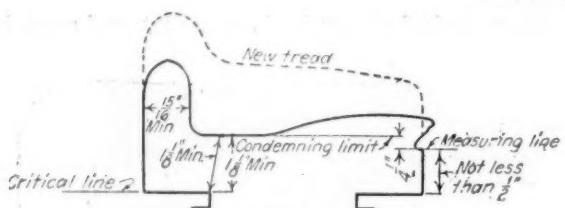


FIG. 1
STEEL TIRE
RETAINING RING FASTENING

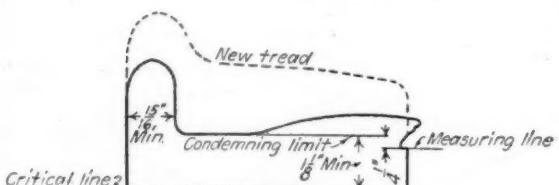


FIG. 2
STEEL TIRE
SHRINKAGE FASTENING ONLY

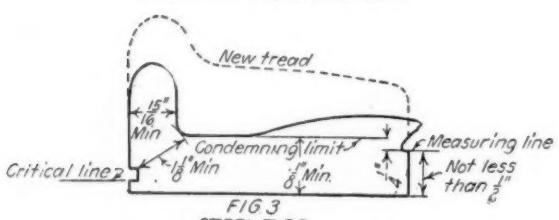


FIG. 3
STEEL TIRE
RETAINING RING FASTENING

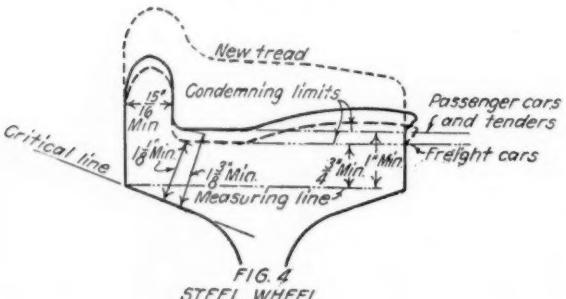


FIG. 4
STEEL WHEEL

fall within the limits of the maximum and minimum standard flange thickness gages shown on Page 41, Section "B," A. R. A. Manual.

(c) THROAT RADIUS.—The radius of the throat shall not vary more than 1/16 in. from that specified.

Rim

(d) TAPE SIZE.—The tape size of 28 in. wheels shall not be less than Tape 32 nor more than Tape 46, 30 in. wheels shall not be less than Tape 82 nor more than Tape 96; 33 in. wheels shall not be less than Tape 157 nor more than Tape 171, and 36 in. wheels shall not be less than Tape 233 nor more than Tape 247.

(e) RIM INTERIOR DIAMETER, BACK FACE OF RIM.—The rim

interior diameter, back face of rim, shall not be less than 22 $\frac{5}{8}$ in. for 28 in. wheels, 24 $\frac{5}{8}$ in. for 30 in. wheels, 27 $\frac{5}{8}$ in. for 33 in. wheels, and 30 $\frac{5}{8}$ in. for 36 in. wheels. The maximum rim interior diameter, back face of rim, shall be governed by the tape size and rim thickness.

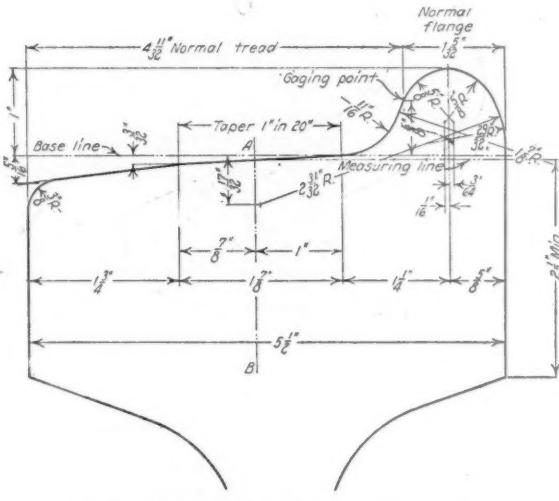
(f) RIM INTERIOR DIAMETER, FRONT FACE OF RIM.—The rim interior diameter, front face of rim shall not exceed the rim interior diameter, back face of rim, nor vary under that dimension by more than $\frac{1}{4}$ in.

(g) THICKNESS OF RIM.—The thickness of the rim shall be measured radially of the wheel, on the back face of the rim, between the inside diameter of the rim and the point at which a line drawn through the intersection of Line "A"-B" and tread of the wheel, parallel to the axis of the wheel, meets the back face of the rim. The thickness of rim thus measured with a standard A. R. A. steel wheel gage, or an approved equivalent shall not be less than $2\frac{1}{2}$ in. and shall not vary more than $\frac{1}{8}$ in. on any two radii in any one wheel.

(g-1) The rim thickness when measured radially on a plane 1 in. from front face of rim shall not vary more than $\frac{1}{8}$ in. on any two radii in any one wheel. The contour of the underside of the rim shall be practically symmetrical either side of the plate.

(h) To facilitate measurement of rim thickness the radius of the inside edge of back face of rim shall not exceed $\frac{1}{8}$ in. A sharp corner is preferable.

(i) ROTUNDITY.—All rolled to finish wheels when gaged with



WHEEL TREAD AND FLANGE FOR STEEL WHEELS

a rotundity gage shall not show an opening between the gage and tread at any point greater than 1/16 in.

(j) BLOCK MARKS ON TREAD.—The maximum height of block marks shall not be greater than 1/64 in.

(k) WIDTH OF RIM.—The width of rim shall not vary more than $\frac{1}{8}$ in. from that specified.

(l) PLANE.—Wheels shall be gaged with a plane gage placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of 1/16 in. from the plane of the same gage when so placed.

Plate

(m) THICKNESS OF PLATE.—The plate thickness may vary but shall not be less than that shown on the drawings.

Hub

(n) DIAMETER OF HUB.—Hub diameter may vary, but wall thickness of finish bored hubs shall not be less than 1 $\frac{1}{4}$ in. at any point for bores 7 in. or less in diameter, nor less than 1 $\frac{1}{2}$ in. for bores more than 7 in. in diameter, and wall thickness for finished bored hubs shall not vary more than $\frac{1}{4}$ in. at any two points on the same wheel.

(o) HUB LENGTH.—The length of the hub shall not vary more than $\frac{1}{8}$ in. from that specified.

(p) DEPRESSION OF HUB.—In connection with wheels to be used with journal boxes bearing on front face of hub, such as car and tender wheels, the depression of hub below front face

of rim shall not be less, but may be as much as $\frac{1}{8}$ in. more, than that specified.

(q) PROJECTION OF HUB.—Wheels to be used with journal boxes bearing on back face of hub, such as locomotive truck wheels, shall be furnished with back face of hub machined to smooth dimensions, or there shall be left on the hub face from $1/16$ in. to $3/16$ in. stock for finishing.

Bore

(r) DIAMETER OF BORE.—The diameter of rough bore shall not vary more than $1/16$ in. over nor more than $\frac{1}{8}$ in. under the dimensions specified. When not specified, the rough bore shall be $\frac{1}{4}$ in. less in diameter than the finished bore, subject to the above limitations.

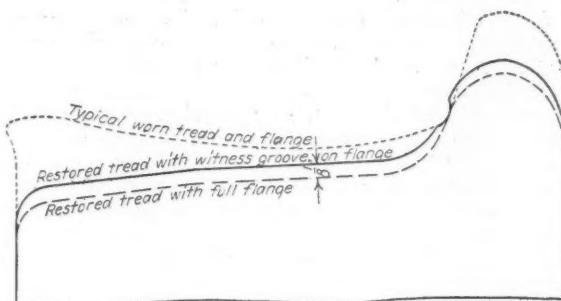
(s) BLACK SPOTS IN HUB.—Black spots will be allowed within 2 in. of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.

(t) ECCENTRICITY OF BORE.—The eccentricity between the tread at line "A" "B" and the rough bore shall not exceed $3/64$ in.

Gages

[Gages referred to are those shown in the Manual, Section B, pages 37, 38, 39, 40, 41 and 43.]

8. BRANDING.—(a) The date, (day, month and year), brand of manufacturer, manufacturer's serial number and heat number and carbon content designation shall be legibly stamped on the



SKETCH SHOWING SAVING IN TREAD METAL WHEN A WITNESS GROOVE IS LEFT IN FLANGE AS COMPARED TO FULL FLANGE CONTOUR.

back face of the rim approximately $\frac{1}{4}$ in. from the inner edge of the rim, as shown on sheet 49, section "D," A. R. A. Manual. The height of characters shall not be less than $\frac{1}{8}$ in. for hot stamping or $\frac{1}{2}$ in. for cold stamping.

(b) The tape size shall be plainly stencilled on the back of the plate in figures at least 1 in. high.

V. Finish

9. FINISH.—(a) The wheels shall be free from injurious defects, and shall have a workmanlike finish.

(b) Wheels shall not be offered for inspection if covered with paint, rust or any other substance, to such an extent as to hide defects.

VI. Inspection

10. INSPECTION.—(a) Inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

(b) The manufacturer shall afford the inspector, free from charge, all reasonable facilities and necessary gages to satisfy him that the wheels are being furnished in accordance with these specifications. Tests and inspection at the place of manufacture shall be made prior to shipment and free of charge to the purchaser.

(c) The purchaser may make the tests to govern the acceptance or rejection of material in his own laboratory or elsewhere, as may be decided by the purchaser. Such tests, however, shall be made at the expense of the purchaser. Any rejection based on such tests shall be reported to the manufacturer within five working days from receipt of samples.

(d) Wheels which show injurious defects while being finished by the purchaser shall be rejected, and the manufacturer promptly notified.

(e) Samples tested in accordance with Section 5, which represent rejected wheels, shall be preserved for two weeks from

date of test report. In case of dissatisfaction with the results of the tests the manufacturer may make claim for a rehearing within that time.

TABLE I. PERMISSIBLE VARIATIONS IN DIMENSIONS OF WROUGHT CARBON STEEL WHEELS—SEE PAGE 1629

	Dimensions	Permissible variations in dimensions	
	FLANGE	OVER	UNDER
(a)	Height	$\frac{1}{16}$ in.	0
(b)	Thickness	$\frac{1}{16}$ in.	$\frac{1}{16}$ in.
(c)	Radius of throat.....	$\frac{1}{16}$ in.	$\frac{1}{16}$ in.
	RIM		
(d)	Tape sizes	14	0
(e)	Rim interior diameter—Back face of rim	Limited by tape size and rim thickness	$\frac{1}{16}$ in.
(f)	Rim interior diameter—Front face of rim in relation to interior diameter—Back face of rim.....	0	$\frac{1}{4}$ in.
(g)	Rim thickness from inner edge of back face to intersection of line A, B and tread.....	Limited by tape size	0
	MAXIMUM ECCENTRICITY IN RELATION TO TREAD $\frac{1}{8}$ IN.		
(g-1)	Variation when measured radially on plane 1 in. from front face of rim.....	$\frac{1}{8}$ in.	
(h)	Inside edge—Back face of rim (measuring line) maximum radius	$\frac{1}{8}$ in.	
(i)	Maximum departure of tread from rotundity	$\frac{1}{16}$ in.	
(j)	Maximum height of block marks on tread	$\frac{1}{64}$ in.	
(k)	Width of rim.....	$\frac{1}{8}$ in.	$\frac{1}{8}$ in.
(l)	Maximum departure of any circle on back face from plane.....	$\frac{1}{16}$ in.	
	PLATE		
(m)	Thickness, variation from that specified	0	
	HUB		
(n)	1. Diameter	Limited by wall thickness	
	2. Minimum thickness of wall, for bores 7 in. or under.....	$1\frac{1}{4}$ in.	
	3. Minimum thickness of wall for bores over 7 in.....	$1\frac{1}{2}$ in.	
	4. Maximum variation in thickness of wall in any one wheel.....	$\frac{1}{4}$ in.	
(o)	Length	$\frac{1}{8}$ in.	$\frac{1}{8}$ in.
(p)	Depression below front face of rim Projection beyond back face of rim: When furnished finished.....	0	0
	When furnished rough.....	$1/16$ in. to $3/16$ in.	0
	BORE		
	(When not specified, rough bore shall be $\frac{1}{4}$ in. less than finish bore)		
(r)	Diameter of rough bore.....		
(s)	Maximum depth of black spots in rough bore within 2 in. of face of hub	$1/16$ in.	$\frac{1}{8}$ in.
(t)	Maximum eccentricity of rough bore in relation to tread.....	Must finish clean	$3/64$ in.

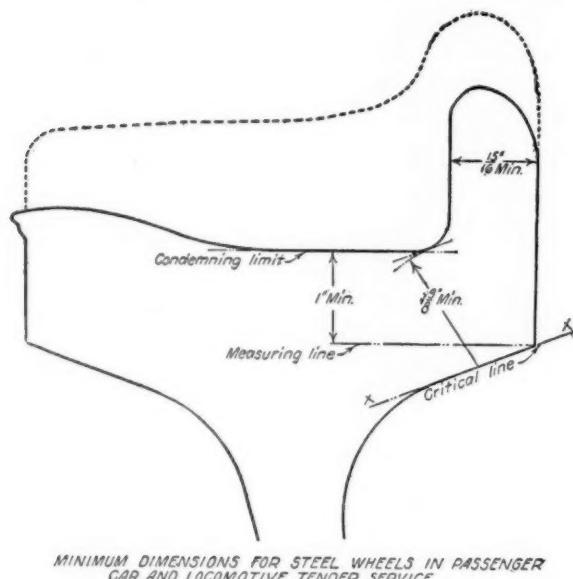
Gage for Steel Wheels

(See illustrations on pages 1630 and 1631)

The present gage for gaging steel wheels has not been found satisfactory, as it is too complicated for the average inspector or wheel lathe hand and there has been a demand for a simpler gage to answer all the requirements, and at the same time a revision of the Code of Rules governing billing for metal in rolled steel wheels through the use of such a gage. The limit of wear line which has been placed on wheels has been found to be an unsatisfactory method of gaging the wheels, because of the fact that the treads wear hollow, and no way is provided to take care of this measurement. Furthermore, the rules governing the maintenance of locomotives issued by the I. C. C. place the limit on the dimensions from the throat to the underside of the back rim. This latter dimension is really the correct dimension for limiting the wear of steel wheels, inasmuch as this is the danger point and not the front rim. The Committee has gone into this matter carefully and has developed a gage which is submitted for approval. This gage takes care of the measurement of amount of metal to be turned off the tread to restore full flange contour as well as the limit of rim thickness. It should be noticed, that it also provides a gage checking the depth and location of witness groove in the flange after turning. It is the

practice of most roads to leave this witness groove in the flange after turning, inasmuch, in this way a large amount of serviceable tread metal is saved. The committee feels that inasmuch as this is a good practice, it should be sanctioned by the Code of Rules, but limitations should be put on the depth and location of the groove. The maximum depth is limited to $3/64$ in. and the location to a minimum of $3/8$ in. above the base line. Changes in the Code of Rules will be necessary to cover this point and are given in another portion of this report. All final gaging of wheels with this new gage will be on the back rim of the wheel. The committee realizes that while the wheels are under the cars, it is difficult to take this measurement, particularly, on the middle wheel of a six-wheel truck. The gage has therefore been designed so that it can be applied to the outside of the wheel by the inspectors on the track, in order to make decision as to whether to remove the wheel. However, the final check after wheel has been removed must be taken from the back side of the flange, as this is the real limiting dimension. The new specifications are drawn up with such tolerances on the inside rim diameter as to make it more readily adaptable to this type of gage.

The illustrations show the methods of applying the new gage for the various measurements. In addition to the uses shown, inspectors can adapt the gage for use in measuring couplers by cutting off the lower end, so that length over all is $5\frac{1}{8}$ in. The gage may also be used by inspectors to gage thin flanges. Figure 8 on the moving finger of the gage represents a flange of 1 in. thickness. Figure 9 represents a flange of $15/16$ in. thickness.



It will be noticed that in the proposed changes in the Code of Rules, it is recommended that either the standard A. R. A. gage must be used for the measurement of the metal in billing or an approved equivalent. One other gage has been presented to the committee and changes have been made which bring it into conformity with the requirements of the A. R. A. gage. This gage which is known as the I. D. Service Metal Wheel Gage, meets with the approval of your Committee and will be considered as an approved equivalent, under the Code of Rules. Any other gages which may be developed will be considered and either approved or condemned.

Changes in Code of Rules

Your Committee recommends the following changes in the Code of Rules to agree with recommendations made in this report:

RULE 72.—Any circumferential seam within $3\frac{3}{4}$ in. limit from flange.

RULE 74.—WORN FLANGES.—Cast iron wheels under cars of less than 80,000 lb. capacity with flanges having flat vertical surface extending 1 in. or more from tread, or flanges $15/16$ in. thick or less, gauged at a point $3/8$ in. above tread.

Wheels under cars of 80,000 lb. capacity or over, with flanges having flat vertical surface extending $7/8$ in. or more from tread, or flanges $1/8$ in. thick or less, gauged at a point $3/8$ in. above tread. See Figs. 3 and 4.

WORN FLANGES.—Wrought steel, steel tired, or cast steel

wheels: Flanges having flat vertical surface, extending 1 in. or more from tread, or flanges $15/16$ in. thick or less. See Figs. 3 and 4.

NOTE: Wording under Figs. 3 and 4 should be changed so as to eliminate cast steel wheels from grouping with cast iron.

RULE 79.—THIN TREAD STEEL WHEELS.—If tread is worn so that tread thickness, as shown by A. R. A. standard wheel gage or its approved equivalent is $\frac{3}{4}$ in.

STEEL TIRED WHEELS.—If tread is worn to within $\frac{1}{4}$ in. of the measuring line which is the inside edge of the limit of wear groove.

RULE 98, PAGE 101.—WROUGHT STEEL WHEELS.—The price for new wrought steel wheels shall be based on scrap value of \$1.90 for metal inside the condemning limit, which is $\frac{3}{4}$ in., as shown by the Standard A. R. A. steel wheel gage or its approved equivalent, plus \$1.52 for $1/16$ in. of service metal (on radius of tread) in connection with standard full flanged contour with allowance for witness groove.

SECOND PARAGRAPH ON PAGE 101 SHOULD HAVE THE FOLLOWING ADDED: The amount of service metal available will be measured on back face of the rim, using the standard A. R. A. steel wheel gage or its approved equivalent.

THIRD PARAGRAPH ON PAGE 101 SHOULD READ: When repairs are not covered by defect charge, the proper credit for any allowance of service metal must be given the owner at the rate of \$1.52 for each $1/16$ in. of service metal removed, measured on radius of tread, in connection with full standard tread and contour with witness groove left in flange and charge shall be made against owner for any increase in service metal. The amount of service metal available to be measured on back face of rim, using the standard A. R. A. steel wheel gage or its approved equivalent. In cases of slid flat wheels, loss of service metal shall be calculated, using standard A. R. A. steel wheel gage or its approved equivalent, measuring on the back face of rim. The measurement of amount of metal to be turned off to true up the flange or tread will be calculated by the use of the standard A. R. A. steel wheel gage or its approved equivalent, measuring on the back face of rim.

INTERPRETATION NO. 1: Should be removed from the Code.

INTERPRETATION NO. 3: Should provide an allowance for witness groove.

RULE 107.—UNDER ITEM 420-D: Change to agree with above rule.

Passenger Car Code of Rules

RULE 7.—ITEM 5: This rule should be changed to permit cast steel wheels to have the same flange thickness limit as the wrought steel wheels.

ITEM 6: Should be changed so as to group the cast steel wheels with the wrought steel wheels and steel tired wheels as regards flange wear limit.

ITEM 13: To Be Changed as Follows: If tread of steel tired wheels is worn to within $\frac{1}{4}$ in. of measuring line, which is the inside edge of the limit of wear groove. On steel wheels if tread is worn to 1 in. thickness, as shown by standard A. R. A. gage or its approved equivalent.

Service metal on steel wheels is to be measured by the standard A. R. A. steel wheel gage or its approved equivalent.

RULE 8.—ITEM (F): Note under this rule should be changed.

RULE 21.—ITEM 26: Allowance should be made for witness groove in the flange and note changed accordingly.

RULE 22.—NOTE UNDER ITEM 55: Should be changed, eliminating reference to the limit of wear groove and also limitations of metal in excess of $1\frac{1}{2}$ in.

Recommendations

The Committee on Wheels recommends the following questions as discussed in this report be submitted to letter ballot:

1. New specifications for cast iron wheels.
 2. New specifications for wrought steel wheels.
 3. Change in scrapping limit of wrought steel wheels.
 4. Change in flange thickness limit for cast steel wheels.
 5. Advancement of 650 lb., 700 lb., and 750 lb. cast iron wheels to Standard Practice.
 6. Adoption of new steel wheel gage as recommended practice.
- The committee also recommends that the various changes in the Code of Rules as listed in this report be considered by the Arbitration Committee.
- This report is signed by C. F. Ripley (Chairman), A. T. & S. F.; O. C. Cromwell, B. & O.; L. K. Silcox, C. M. & St. P.; H. C. Manchester, D. L. & W.; E. W. Smith, Penn. System, and P. H. Dudley, N. Y. C.

Discussion

[Instead of reading the report the chairman, C. T. Ripley, commented briefly on the different subjects, with explanatory remarks covering the reasons for the conclusions reached by the committee.]

MR. RIPLEY: There are several changes in the specification for cast-iron wheels which are the result of discussions and various new ideas brought forward in the last few years. Chemical specifications have been added.

The committee recommends the advancement of the new weight, arch plate wheels to standard practice instead of recommended practice, and also suggests to the Arbitration Committee that the use of these wheels be made compulsory in interchange. Our object was to do away with the practice which now exists on some railroads and on some private car lines of using lighter weight and differently designed wheels which are not felt to be safe in operation in mountainous territory. This subject has already been covered in the report of the Arbitration Committee.

The taper of the tread on both steel and cast-iron wheels was discussed at a joint meeting of the committee and representatives of the A. R. E. A. The committee felt that the existing taper should be retained for the present, but that consideration should be given to a change in the length of the 1 in 20 taper; that is, to come to something approaching a continuous taper or at least an extension of the present 1 in 20 taper closer to the edge of the rim. The idea in this is to get a large bearing area on the rail and thus increase the life of the rail. This committee desires to do everything to co-operate with the civil engineers which it can do without decreasing unduly the life of the wheels.

The committee was requested to go into the question of grinding new cast-iron car wheels before they are put into service. We have in former reports discussed the grinding of slid-flat wheels, and this practice is now followed by a number of the large railroads.

There is an advantage also in the grinding of new wheels, due to the fact that they are out of round, and due both to defects in casting and defects in mounting. Making them truly round will make them run better and should reduce the number of flat spots and be easier on both track and cars. One large railroad is following this practice, and I hope their representative will discuss the results.

The next subject is seams in cast-iron wheels. The committee recommended that the Arbitration Committee increase the severity of this rule in order to avoid any chance of accident due to hidden seams, and the Arbitration Committee's report has covered this.

The next subject has reference to flange thickness for cast-steel wheels. The manufacturers of cast-steel wheels are loath to believe that they should be thrown in the class of the cast-iron wheels, due to the strength of their flanges. This committee made experiments on the breakage of flanges in a few classes of wheels for scrapping limits, under specially constructed devices in drop-test machines, and found this claim was well warranted. We have, therefore, recommended that the code of rules be changed, throwing the cast-steel wheel into the class of the rolled-steel and wrought-steel wheels.

I would also like to call attention to the drawing of the steel wheel gage. There is an error in this drawing in the dimension in the right hand upper corner which was designed for measuring vertical flanges of cast-iron wheels. This should be $\frac{7}{8}$ in. There is also one other error in the drawing showing the saving involved in the use of a witness groove. There is a small lip of metal which projects beyond the line shown for the worn flange. This is an error.

I have a gage of this type here if anyone is interested in seeing it and its application.

F. M. WARING (Penn. System): We have had no experience in buying cast-iron wheels to chemical specification and therefore have no suggestion to offer on the proposed specifications. There were just a few points to which I would like to call the attention of the committee and possibly ask for a little further explanation.

On the table showing the height of drop for the different weights of wheels, the 850-lb. wheel is given a 13-ft. drop. It seemed to us that might possibly be 15 ft., in order to be in line with the proportion existing in the drops of other weights of wheels.

Under the section on chemical composition we have been getting some cast-iron wheels in which the combined carbon would run as high as one per cent, and we questioned whether those wheels (apparently good in every other respect, sound, good chill, met all the thermal and drop tests satisfactorily) should be rejected be-

cause they were one per cent instead of 9/10 per cent combined carbon.

Manganese is limited to .50 as minimum, but we sometimes get wheels which run .13 or 14 sulphur with .45 manganese, and it was a question in our minds whether those wheels were properly rejected as they would be under a strict interpretation of these specifications.

Condemning Limit for Steel Wheels

The only other point we have to bring up is in connection with the rolled-steel wheel condemning limit. Your committee recommended that the condemning limit for rolled-steel wheels in freight car service be reduced $\frac{1}{4}$ in. and the limits for tender and box car wheels be left as they are now shown in the standard 1 in. We think that this does not fully cover the present conditions where larger axles, such as the *E* and *F* axle, and heavier wheel loads have come into use since the original limits were prepared.

We would be glad to have the committee give consideration to this suggestion, and if it meets with their approval, perhaps incorporate it with their report today or make such modification of our suggestion as they may see fit.

We would suggest that the recommendation read as follows:

"The minimum rim thickness for condemning limit shall be $\frac{3}{4}$ in. for wheels on all axles in freight service up to and including the *E* axle, 6 in. by 11 in., and for all axles in passenger service up to and including the *D* axles, $5\frac{1}{2}$ in. by 10 in. The minimum 1-in. thickness of rim shall be maintained for wheels on the *F* axles, $6\frac{1}{2}$ in. by 12 in., in freight service, and for the *E* and *F* axles in passenger service and for all tender and engine truck wheels."

Mr. Ripley: As regards the height of drop, this was a question given considerable discussion. You will note in our report we did not recommend that the 850-lb. wheel be advanced to standard. There are some indications that our design in that weight is not what it should be as yet.

The experiments at the plants with the drop tests which have been made seem to indicate that in this design 13 ft. is a proper height for the test. However, that particular wheel is going to be studied further by the committee in the coming year, possibly recommending changes in the design and in the specification for the axle.

I wish to call to your attention that under that table there is a new clause which makes the drop test mean something; that is, it says that if a wheel cracks at the third blow, or if it is rejected under the old system, we had to keep hammering it until it broke in half; in other words, we put the teeth into that test, as well as several other tests, that make them mean something, so that this specification for 13 ft. means a whole lot more than the old specification for 15 ft.

As regards the carbon allowance, that question was one which involved a great deal of argument. In the majority opinion of the committee, 0.90 per cent was as high as the carbon should go, the idea being that this carbon indicates the annealing. That is the real story, how it is annealed after being taken out of the molds. If not handled properly, the combined carbon is liable to be high and this causes wheels to snap in service, breaking at the plate.

As regards manganese, sulphur and carbon content, the manufacturers in their meeting, after much argument, finally accepted this specification as one which they could meet and which they felt would make a good wheel. I believe the limits which we have set, while not as close and as fine as some representatives have wanted, are fair both from the users' and manufacturers' viewpoints and should result in a high quality product.

When it comes to the condemning limit for steel wheels, I must say that the committee did not give particular consideration to this *F* axle. Unfortunately there are very few roads using this axle and there is a limited experience from which we could judge. We will, however, be very glad to give that consideration and gather some data. It is possible that the limit should be different on this very large axle. We do not, however, wish to go along with the recommendation that the passenger car wheels have their condemning limit cut down at the present time. We may feel that it is proper practice, but inasmuch as we can get the service life out of these wheels by transferring them from passenger service to freight service after they have reached this limit, why not go along at least for a year or two in that way? Then, if the practice proves as we believe it will, to be entirely safe, we can go still further and make the limit the same on passenger cars and freight cars.

Mr. Coddington (N. & W.) (written discussion): After re-

viewing this excellent and thorough report the Wheel Committee has prepared on this subject, it was with some hesitation that the writer consented to prepare a discussion upon certain features of the report.

The action of the committee in recommending a reduction of $\frac{1}{4}$ in. in the rim thickness condemning limit for wrought steel wheels in freight service is going to result in marked economy in the use of steel wheels if adopted as a standard practice, since it increases the available service metal of the wheel 16 per cent. In confirmation of the findings of the committee as to the safety of such wheels, it may be of interest to state that before the Federal laws fixed the limits of wear for wrought steel wheels in tender service, it was the practice on the road with which the writer is associated to use under locomotive tenders wheels that were outlawed by the Interchange Rules for rim thickness, and no wheel failures ever resulted from this practice. A number of wrought steel wheels have been removed from freight service with only $\frac{5}{8}$ in. rim thickness. In no instance has a wrought steel wheel with rim thickness even below the recommended limits failed or shown any indication of failure in service.

Carbon Content and Flange Wear

Under the caption "Mating," it is specified that steel wheels be stamped by the manufacturers with the carbon range. There has been a general impression that the carbon content was a very potent factor entering into the rate of flange wear. The opinion on the Norfolk & Western was that the carbon content was an important factor in flange wear until the conclusion of some extensive tests indicated that unless the carbon range was ten or more points, the influence did not necessarily affect the flange wear. This conclusion was reached after the following information was established:

Difference in carbon between wheels of each pair considered (per cent)	No. of service periods	Average flange wear in inches	
		High carbon	Low carbon
.00	12	.12	.09
.01	55	.11	.09
.02	27	.13	.11
.03	34	.11	.13
.04	35	.11	.09
.05	32	.11	.13
.06	24	.08	.12
.07	18	.14	.10
.08	15	.09	.11
.09	11	.14	.08
.10	7	.10	.17
.11	4	.09	.13
.12	7	.09	.14
.13	6	.08	.10
.14	6	.05	.22
.01 to .09	263	.11	.11
.10 to .14	30	.08	.15
.01 to .14	293	.11	.11

The first column in the table refers to the number of points difference in carbon; the second column shows the number of runs the wheels considered have made, while the flange wear is shown in the third and fourth columns. For instance, where the difference in carbon is one point, the average flange wear of the higher carbon is entered under "High Carbon" and the low carbon under "Low Carbon." It will be noticed that the maximum flange wear does not follow the condition of high and low carbon until a difference of ten points is considered. From ten points up to fourteen points, both inclusive, the flange wear on the low carbon wheels is greater.

The summary under this table puts the subject in a more condensed form. With a carbon range of one to nine, inclusive, in which 263 service periods were considered, the average flange wear for the high carbon wheels and the low carbon wheels was identical, viz., .011. From ten to fourteen points difference, inclusive, 30 service periods considered, the average flange wear was .08 for the high carbon and .15 for the low carbon wheels.

The recognition of the influence of the carbon content with reference to wearing properties, is all right, but it is believed that a difference of ten points would be a more practical range than five points.

Interior Diameter of Rim

Under the subject, "Rim Interior Diameter, Back Face of Rim," the minimum rim interior diameter for the 33-in. wheels is fixed at $27\frac{1}{8}$ in. Reference is made particularly to the 33-in. wheels, as this size of wheel is in more general use. In fixing this dimension consideration should be given the diameter at which wheels would be scrapped according to the proposed rules. A wheel with $29\frac{1}{2}$ in.

inside diameter of rim, plus $1\frac{1}{2}$ in. diametrical rim thickness, equals $29\frac{1}{8}$ in. tread diameter at the scrapping limit. This dimension is $\frac{7}{8}$ in. under the existing scrapping limit, which is $\frac{1}{4}$ in. above the limit of wear groove based on a diameter of $29\frac{1}{2}$ in.

Some trouble has already been experienced in wearing 33-in. diameter wheels down to their present scrapping limit on account of the shimming required to maintain coupler height and truck clearances, and for this reason the scrapping diameter of the wheel measured over the rim should be lowered as little as possible below the existing practice, and in order to better meet this condition, it is believed, and it seems consistent, that the minimum interior rim diameter should be $27\frac{1}{8}$ in. instead of $27\frac{1}{4}$ in. This change will bring the diameter at the scrapping limit more nearly to what it has formerly been and will avoid the use of wheels with excess material in the rim that cannot be utilized in service. Since the committee recommends that the minimum tape be increased five points, it does not appear consistent to recommend a decrease in the rim interior diameter.

While reference is made only to the 33-in. diameter wheels, the same deductions might apply to wheels of 28, 30 and 36 in. diameter.

Reference is made to Interchange Rule No. 98, which fixes the basis for accounting for the value of wrought steel wheels, but it does not fix a maximum limitation for this charge. The existing rule specifies that the charge for wheels shall not be in excess of $1\frac{1}{2}$ -in. service metal. In view of the changes made to provide for utilizing $\frac{1}{4}$ in. additional tread thickness, it is believed that the present $1\frac{1}{2}$ -in. limit should be increased to $1\frac{3}{4}$ -in. of service metal.

The purpose for recommending such a limit is that under certain conditions a road applying new wheels of maximum tape dimensions and minimum interior rim diameter would be charging an extortionate price for the material furnished. For example, and to use an extreme case, should a wheel with $27\frac{1}{8}$ -in. minimum rim diameter, with a maximum tape of 171, be applied on a foreign line, according to the proposed ruling, charge could be made against the owning road for $2\frac{1}{4}$ -in. service metal, which, at the existing rate, would amount to \$54.72 per wheel.

At the present time, wrought steel wheels can be purchased in quantities at between \$30 and \$35 each. This additional charge of approximately \$20 in excess of the cost of the wheel would be a hardship upon the owning road, and it is quite probable that railroads applying steel wheels to foreign cars might exploit this practice as a matter of revenue.

Steel Wheel Gage

The adoption of a wheel gage as recommended marks a step of progress in wheel gage design. A gage of this design is not new and untried, as a similar one has been employed on the Norfolk & Western for a number of years. Its adaptability for the service and advantages gained by its use have been thoroughly established.

One point of particular importance is that with this system of measuring, the rim thickness is gaged from the inside edge of the rim, from which point the critical dimension for rim thickness is measured and no provision has previously been made for determining this very important dimension.

The convenience by which the amount of service metal to be removed in restoring the contour of a worn wheel and at the same time determine the amount of available service metal remaining, after the restoration of the contour, are particularly advantageous features of the proposed gage.

It is also observed that in this gage, provision has been made for taking care of all wheel tread and rim dimensions, thus making it unnecessary to carry additional gages.

Re-mating Worn Wheels

The committee in the introduction of the proposed standard wheel gage has referred only to its application in interchange proceedings. Since the same gage can be employed in the conservation of service metal when wheels are scheduled for turning, brief mention will be made of possible economies resulting from its use in this connection. By using this gage and a conveniently arranged table, the finished tape size of a worn wheel can be readily determined and this size marked on the plate of the wheel. It has been found profitable, as well as practicable, in handling steel wheels scheduled for turning, to strip and re-mate wheels that vary five tape points in finished tape size. By following this practice and re-mating wheels marked to finish at like tape sizes, the turning operation can be accomplished with a minimum loss of available wearing material.

Anticipating that the remounting program will immediately

come into the minds of many, assurance is given that it has been found by careful selection, the wheels can be remounted without having to refit by boring the wheels or turning the axles. In a shop where this practice has been standard for several years, it is rarely ever necessary to refit by boring or turning.

The economies resulting from this practice of handling wheels are of such proportions as to appear almost spectacular. Considering a group of 50 pairs of wheels as they went through the shop without selection, a record was kept of the available wearing material saved on these 50 pairs or 100 wheels by re-mating and turning according to the dictation of the wheel gage. It was found that 25 7/16 in. of service metal was saved in this one group of wheels over what would have been the experience had they been turned as pairs.

The value of this service metal on the basis of the A. R. A. allowance for 1/16 in. is \$390.64. Allowing \$90 additional cost for stripping and re-mating, which is a liberal allowance, there is still a net saving of \$300 or an average of \$3 a wheel.

By requiring the wheel shop to make a report of all wheels turned according to a standard form, it is possible for the proper supervising officer to determine if the wheels were turned with the minimum loss of service metal. The form referred to has the following headings:

Report of Wrought Steel Wheels Turned for Week Ending.....
Wheel No.... Gage Reading.... Tape Before Turning.... Tape
After Turning.... Turned Acct. of....

The same practice of conserving service metal can be applied in the handling of locomotive flanged tires as well as the handling of car wheels. In addition to the use and the conservation of metal in the handling of steel wheels, the same application of the gage will apply in the handling of steel tires.

H. M. North (Pullman Company): Our experience supports the conclusion of this committee as shown in this report in that feature which intimately concerns the Pullman Company—the conservation of metal in the rolled steel passenger wheels. There has been under way at the Pullman Car Works at Pullman and in the shops of the Pullman Company about the United States for about nine months past a faithful effort to determine if we were securing the utmost mileage consistent with complete safety which the wheel we purchase can render. We found great need of some such mechanical device as he has shown for determining what amount of metal should be turned off from the wheels and how it should be done. It need not be one precise type of gage or gages, but the result should be that which the committee recommends in its report.

The old question of whether a witness groove is safe or unsafe has been treated thoroughly. Speaking for the Pullman Company, I wish to subscribe to the depth measuring horizontally into the flange which the committee recommends; that is, 3/64 in. In many sections which were laid out on the drafting table from worn wheel sections, secured by plaster of Paris casts, in no case did the groove of that depth encroach to the throat of the wheel. In no case was there evidence that it might engage a sharply worn switch, switch point, or sharp frog.

The results of the Pullman Company study and effort are shown in carefully made-up graphic forms which are at the disposition of the members who are particularly interested.

H. J. Force (D. L. & W.): I want to refer to one or two points brought out by Mr. Waring with reference to the carbon and sulphur contents of cast iron wheels. I have done a great deal of work with this committee in connection with the chemical and physical requirements of cast iron wheels and every member of that committee fully realizes the responsibility upon his shoulders for a new specification for cast iron wheels.

Tests Determine Cause of Wheel Failures

The committee in going into this work has tried first of all to find out why it was that some of these cast iron wheels have failed in service, and I have taken a large number of wheels which have failed and which have caused wrecks and derailments and submitted them to very careful chemical analysis, we find that in nearly every case those wheels are sometimes as high as 1.25 and 1.30 and the combined carbon in many of them is around .90 and .95. Therefore by taking into account these various elements we can arrive at a conclusion that a composition of that kind is more or less dangerous and the specification therefore has been set at not more than .90 carbon.

On the other hand, higher carbon than .90 will increase the

shrinkage in the cast iron wheel, making it much more difficult to anneal and relieve shrinkage strains. Therefore, with a carbon very much lower than .90 we have less difficulty in making the proper annealing.

Sulphur Content in Cast Iron Wheels

In reference to the sulphur content, that is probably one of the most sinister elements we have to deal with in cast iron, and as you gentlemen all know in no other specification have we a sulphur content above .12 and with the cast iron wheels we allow it to go up as high at the present time as .16 and to be gradually reduced down to .14 per cent.

In order to test out these theories we have taken a number of wheels and repeated the thermal test. The new thermal test as applied in this specification has been increased from 1 1/2 in. to 1 3/4 in. and 2 in., according to the weight of the wheel. We have also said in the specification that the wheel must stay in the thermal test two minutes and not crack, while in the old requirement the wheel may crack in the thermal test but not crack through into the rim.

I have taken those wheels and laid them in the sand, put on the test and held it for ten minutes, and have taken the wheel out and have reapplied that ten or eleven times before I was able to break that wheel. There is a wonderful improvement over the old wheel and the composition on those wheels is very close to .70 combined carbon, proving again that if we go into the higher carbon we are more than likely to have failures.

I would also remind you, that your specification for steel wheels is not more than .85 carbon. In that case your carbon is all combined. Therefore we certainly should have a lower combined carbon in the cast iron for the reason that the carbon in cast iron and in steel is in exactly the same combination. The higher the combined carbon the more brittle the steel or the iron will become. On the other hand, with cast iron wheels we have high sulphur and high phosphorus. Therefore it is important that these elements should be controlled as closely as possible.

The Association of Manufacturers of Chilled Car Wheels has endorsed these specifications. The wheel manufacturers realize that a better wheel must be produced and the only way it can be produced is by closely controlling the chemical composition.

When wheels are placed in the soaking pit, they are piled 14 or 15 high, and the wheels that are on the top and the bottom are going to be the weakest wheels for the reason that they will not be as thoroughly annealed as the wheels in the middle. Therefore, if the carbon content is at the extreme top limit, of nearly one per cent, it is very evident that that type of wheel is going to fail if placed in service, and those things must be taken into consideration.

Being closely connected with a foundry for the past 14 years, I know that there is no difficulty whatever in making wheels with combined carbon, well below .90. It is the practice of many car wheel makers when they are melting iron to use a mixture where they are trying to melt ten pounds of iron with one pound of coal. The result is they never get the iron hot enough to absorb the carbon, and the result is low carbon, high shrinkage, and a very defective, inferior and dirty wheel, sometimes with blow holes in it. There is no reason whatever why the quantity of iron cannot be reduced in proportion to the coke charged, and make it a formula of 1 to 8. In each case if the process is properly carried out by men of experience, they can produce and have produced, on these tests, over 45,000 cast iron wheels which we closely followed through, and which do meet these specifications.

O. C. Cromwell (B. & O.): The chemical analysis of wheels is a matter that has been studied for a number of years and has been considered by the wheel committee, necessarily for a considerable period of time, because of the location of the makers in the different sections of the country. Conditions vary so that it is necessary to take time and considerable data before coming to a conclusion.

The Baltimore & Ohio has been studying this question of chemistry of wheels for about 30 years. I think some other railroads have studied it nearly as long. The difficulty of the wheel committee was to arrive at proportions that would not bring hardship on anybody, and yet produce the best results.

There has been a demand for improvement in the specifications, and that is one of the clauses that is introduced. We have also increased the severity of the tests. Mr. Waring spoke of the decrease in the number of blows on the 850-lb. wheel from 15 to 13.

That was very thoroughly discussed, and that wheel is under further consideration.

The manufacturers of chilled iron wheels have been in very close touch with the committee in the preparation of these specifications and action has not been taken without being thoroughly in conference with them.

The thermal test is one that has been made considerably more stringent. We believe that that more nearly approximates service conditions than any other of the tests, and we are giving it very close consideration.

In our investigation of the service of wheels we found a great many rolled steel wheels being taken out of service because of not having sufficient metal in the tread to get the third turning, and for that reason we have increased the number of tape sizes so as to be sure in all cases we will get a life of three runs out of the wheel. The use of the rolled steel wheel on 6-in. by 11-in. axles in freight car service is a matter that the committee had not very much data upon and consequently was glad to have the information that is presented to them today.

Mr. Knapp (N. Y. C.) : I would like to say in behalf of the committee that in writing steel wheel specifications we attempted to overcome some of the uncertain features that were present in the former specifications and finally concluded that each member of the committee should become as thoroughly familiar with mill practice as it was practicable to do in addition to his knowledge of railroad practice in using solid steel wheels.

Each member of the committee has visited for some length of time, at least one wheel plant; some of us, several of them. The specifications were gone over with the manufacturers paragraph by paragraph and the final development represents our best thought in promoting the interests of the purchasers of wrought steel wheels.

In connection with the paragraph relating to mating by carbon content, the New York Central has required wheels to be related in carbon content for ten years and we have not as yet developed any reason for abandoning that practice. The specification ranges of five points as mentioned really permit a range of six points in carbon content. This only applies when specified by the purchaser. Each railroad may follow its own best judgment in indicating the carbon ranges for its wheels.

The principal change in the specification is in reference to the rim. Heretofore the specifications touched but lightly upon rim dimensions, although the rim is the only thing that we get out of a steel wheel for the money we pay for it. The rims were permitted to vary to the extent of 3/16 in. under the 2½ in. that we bought and paid for, the only requirement to the manufacturer touching upon average rim thickness. It was perhaps overlooked many times that two wheels of the same tape size might have 3/16 in. under in one rim and 3/16 in. over the standard in the other, but in the practice of nearly all railroads the wheels would be mated to the tape size and scrapped together. The average rim thickness did not appear to the committee as a proper method of judging wheels in accepting them at the steel wheel plants.

Regarding the rim interior diameters to which Mr. Coddington referred, I would like to call the attention of the members of the association to the fact that the rim interior diameters were never mentioned heretofore. The only definite control of the wheel rim was by tape sizes, five tapes under and nine tapes over. There was an additional feature, the limit of wear groove. We have finally drawn the specification in such a way as to fix the interior diameter of the rim and the exterior diameter so that no wheel purchased will have less than a 2½-in. rim thickness. If there is any tolerance or variation in that important dimension it is required to be over.

As to the 27½-in. particularly referred to by Mr. Coddington for the 33-in. diameter wheel, we considered seriously specifying a fixed diameter for the interior diameter of the 33-in. and all other diameter wheels. We soon found that if we were to specify that dimension the manufacturers would simply machine off the metal that might be rolled into the rim. It is a rolling proposition and we would pay for the machining and we would lose whatever extra metal might obtain in the rim under 28 in. maximum diameter. We have drawn these specifications so as to specify that no wheels shall be less than 33 in. outside diameter and if any variation in the interior diameter obtains it will thicken the rim rather than make it less in thickness.

The other feature referred to by Mr. Coddington is in connection with interchange charges. The rates per 1/16 in. of metal,

I understand, are fixed by the Arbitration Committee. We feel that we have drawn the specification in reference to sixteenths service metal in such a way as to insure every purchaser the full thickness to start with.

The price that one wheel may bring in interchange is so far as I can see amply protected by the rules governing the interchange of various wheels. The elimination of the limit of wear groove and the measurement of the wheels on the back insures that no wheel may be placed in service with a less thickness than is considered proper through the critical line and all measurements for interchanges will be conducted by means of that gage and through that dimension.

J. H. Gibboney (N. & W.) : I hesitate to make any further addition to this discussion, but the Norfolk & Western wants to go on record in favor of any movement toward adopting a chemical limitation for cast iron wheels. The Norfolk & Western has not been buying wheels in any great quantities in the past years, but it has been manufacturing wheels in large quantities for 40 years, and the question of chemical limitations to control our practice has been closely followed for at least 30 years to cover such features as the proper selection of materials, scrap and pig irons, and measuring of those materials on that basis and following the product as it came from the cupola.

We want to go on record that the chemical composition of cast iron has a direct bearing on safety and service. That is established by our records. The limitations that have been advanced by the committee are liberal and really workable. I believe they would defeat the entire purpose we have in mind by making those limitations too exact or too liberal. The committee has struck a happy medium, one that we have been following with a slight modification with reference to carbon for a great many years.

Ten years ago or more our railroad commenced to agitate the question of controlling sulphur. The controlling of sulphur in cast iron is not only in the matter of cupola operation but it is a matter of economics.

We have thousands and thousands of cast iron wheels in this country of high sulphur content and those wheels must be remelted into the product we get today if the cast iron wheel is to be economical. Therefore, it is up to us to determine how far we can go. On the Norfolk & Western we use a certain proportion of foreign wheels and a large proportion of our own wheels. In that way we have been able to keep our sulphur content low. The committee in dealing with the matter of sulphur has adopted the suggestion of a sliding scale for sulphur content which will allow the use of a great number of wheels for remelting.

H. T. Bentley (C. & N. W.) : The committee should be commended for an important step in advance and *I would like to suggest a rising vote of thanks to the committee.*

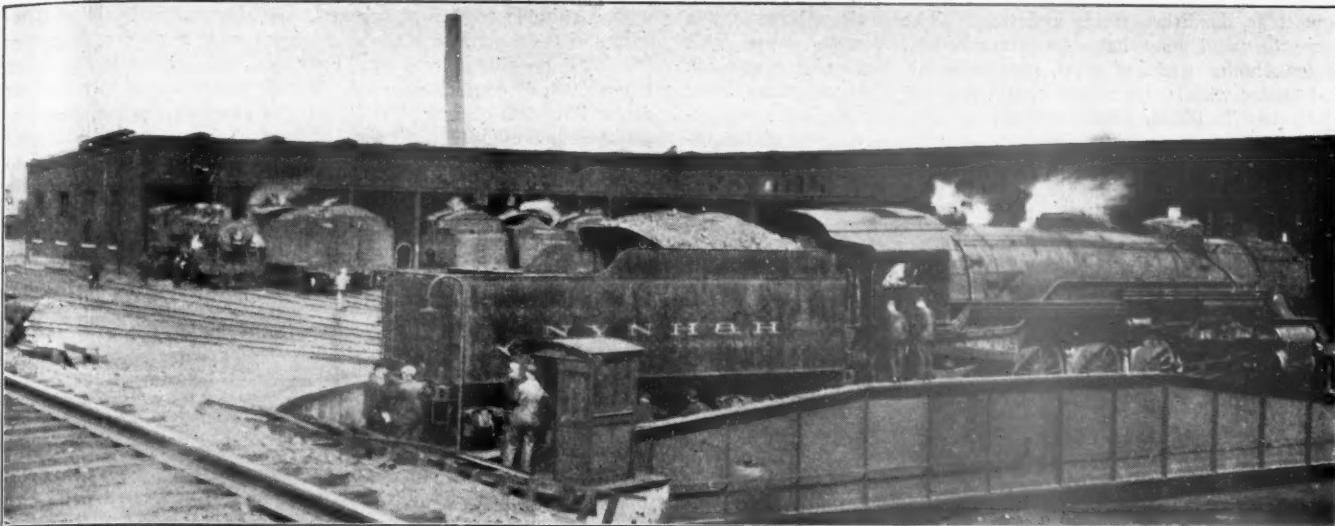
(Whereupon the convention arose en masse.)

Mr. Ripley: *I move that the report be adopted and the recommendations contained submitted to letter ballot for adoption.*

(This motion was seconded and carried.)



Union Station at Toronto, Used as an Office Building, but Not Yet by Trains



Modern 36-Stall Enginehouse of the Rectangular Type

Report on Shops and Engine Terminals

The Work of Previous Committees Has Been Condensed
and Co-ordinated in This Report

Exhibit A—Engine Terminals

THE following is a summary of the data gathered in 1922 by the American Railway Association committee on Design and Operation of Engine Terminals, plus a certain amount of information published by the American Railway Engineering Association on this subject:

General Layout of Terminal

Terminals are all more or less of a compromise. There are so many circumscribed elements affecting each point that no matter whether the terminal is built by gradual expansion or is constructed new, the final arrangement will generally reveal some undesirable features. A good labor market will often overbalance the selection of a site which would have been of greater strategic value. The site selected should be such that soil water will not drain into the house or turntable pit. Enough land should be acquired to allow for 100 per cent expansion in the future. Many variable factors enter into the best selection of a site; proximity of transportation yards, cost and availability of land, distance from passenger station, necessity for smoke abatement, street car or other transportation, etc.

Studies along broad lines should be made before a terminal layout best suited to meet present conditions and future demands can be adopted. Investigation will frequently reveal the fact that a reduction in delay at modernized terminals will be equivalent to adding power to the division. The typical engine terminal is considered as a division clearing house and it is assumed that it literally controls the amount of freight and passenger-service that can be furnished by the transportation department.

A sub-committee of the American Railway Engineering Association, collaborating with a committee of the Mechanical Division, American Railway Association, submitted a typical terminal layout plan at the 1922 convention of the American Railway Engineering Association. This plan shows a large terminal with provision for two houses and separate sets of facilities for handling fuel, water, coal, sand, ashes, etc.

Here follows a quotation from the report devoted to general considerations of engine terminal layout.

Summarizing, engine terminals must be laid out so that one operation will not interfere with another. The importance of this cannot be over-emphasized. If one operation depends upon another for its success, unless that one is a success, the other will be a

failure. Each facility should be independent to an extent that if any one unit or operation should fail it would not have the effect of stopping or retarding the operation of the terminal. Few operations can be conducted efficiently for any length of time if the facilities are strained to the limit. To this end each facility should be designed to perform double the work ordinarily required and at important terminals duplicate facilities should be provided. A single track lead to an engine house is inexcusable. With three or more tracks available a majority should be assigned to incoming engines. Sufficient leads, switches, and crossovers must be provided to avoid delays at coaling station, ash pit, inspection pit, or other facility. As a general rule a number of short leads are preferable to a single long lead as this enables one engine to move independently of others. Where number of leads is restricted frequent crossover switches should be provided to prevent blocking any locomotive. Lead track to turntable should line up with corresponding tracks in engine house for convenience in placing dead engines in the house.

Enginehouse Design—General Features

Modern enginehouses divide themselves into three classes; a brick wall with wood frame and roof, reinforced concrete frame and roof, and a combination of steel frame and reinforced concrete. The first mentioned type is cheapest and most generally used, but the trend has been toward reinforced concrete. All enginehouses should be of fire-proof construction as far as possible. In designing an enginehouse provision should be made for doubling the capacity needed. It is first necessary to determine the class of repairs to be made to power and the extent of such repairs. This involves a study of the capacity for doing such work at other terminals to which the engines run. Also the proximity of a back shop largely determines the extent of repairs necessary in the enginehouse. It is desirable to locate the house some distance from a city in order to get cheaper land, but in leaving the city care should be taken not to get too far away from an adequate labor market. The number of stalls to be provided is a function of the engines to be handled and the expected detention. If 100 engines are to be cared for and each may occupy a pit 12 hours, then 50 pits will be needed. If the average detention is only 8 hours a day then 34 stalls will be ample. Quality of water, as affecting boilers, and amount of local switching may also exert considerable influence upon the number of stalls necessary.

Enginehouses are made in various cross sections to suit local

conditions, facilities, funds and taste. The modern house for a large terminal may have an overhead crane with down draft system, boiler washing plant, drop pits for driving, engine truck and tender wheels, jib cranes at frequent intervals and many other up-to-date facilities. Practically all of the later designed engine-houses have increased head room to improve ventilation and lighting. The continuous monitor type of house, single or double, is now being more generally adopted. The depth of the house, over all length of section, has now increased to 132 ft. on several large roads. The rear walls of the house (outer circle walls) should be practically all windows if good lighting is desired. Window sills should be about four feet from the floor.

In some localities the shape of the property makes a rectangular house fit better than a round house. For large stations a transfer table may be located between two transverse rectangular engine-houses and some rectangular layouts will require both a transfer table and a turntable. A transverse rectangular house is preferable to a longitudinal arrangement. The rectangular house, owing to its parallel spacing of pits, is much easier and cheaper to build than a round house. One particular advantage of the rectangular house with a wye is the saving in space permitted inside the building on account of the parallel track arrangement. Also the building may be designed so that it may be increased by adding multiples as desired. Leads and wye tracks cost less to maintain than turntables. The vulnerability of the turntable to accident is pointed out as a reason for the wye arrangement.

Enginehouses should be designed so that both engine and tender trucks can be removed at the same time, with tender cut loose, if desired. The distance from the engine pilot to the outer wall varies from 8 to 15 ft. and from tender to inside doors, 5 to 10 ft.; distance from engine to side walls from 5 to 10 ft. Doors vary from 12 to 14 ft. wide and from 14 to 18 ft. high. Doors are made of wood or steel frame, swinging, and rolling wood or steel slats. Columns may be omitted in the drop pit section and trusses substituted. This provides a clear passage for moving wheels from pits to rear of house. Outer row of columns should be made strong enough to support jib cranes, which may then be installed at any time desired.

In January, 1921, a committee of the American Railway Engineering Association collaborating with a committee of the Mechanical Division, American Railway Association sent out a questionnaire covering the principal features of enginehouse design. Here follows a short quotation from the 1922 report of this committee.

The Mechanical Division committee recommends a permanent floor, preferably wood block or brick on a concrete foundation for the outer half of the house where most trucking is done. Concrete is satisfactory for the remainder of the floor. The floor should slope from the line of columns between pits to drain into pits, about $\frac{1}{8}$ in. per ft. The committee considers the ideal floor to be of creosoted wood block (12 lb. per cu. ft.), laid direct on a six-in. concrete base with a bituminous cushion and filler. Such a floor is easy to truck over and work on and does not damage engine parts and tools dropped on it. The floor will be waterproof. Floor between pits can be made cheaper than in the outside circle where most trucking is done. The roof structure recommended is to be fire proof and is a combination of reinforced concrete and tile. Non-fire-proof roof to be wood of slow burning construction.

Replies to the questionnaire indicated a marked preference for swinging wood doors. Rolling lift doors are not as satisfactory on account of the liability of getting out of order and the difficulty in repairing damage done by engines. The committee recommends the wood swinging door as satisfactory and easy to keep in repair. Door openings should not be less than 17 ft. in clear height and 13 ft. in clear width. The replies to questionnaire developed the general opinion that there is no satisfactory smoke jack. Cast iron is the first choice, asbestos second, and wood third. Wood, fire-proofed appears to be as satisfactory as any other type. The smoke jack hood recommended is 42 to 48 in. wide and at least 10 ft. and preferably 12 ft. long with a flue opening of at least 7 sq. ft. All piping, etc., should as far as possible be maintained outside the path an engine would take in passing through the outer wall of the house, account of accident.

Turtable, Tractor and Pit

Turtables are now generally 100 to 110 ft. long and 120 ft. is being used for Mallet engines. All turtables should be equipped

with a suitable tractor or tractors. A Mechanical Division Committee of the American Railway Association at a meeting December 15, 1920, concluded that one turntable was ordinarily sufficient for a 50-stall enginehouse. A 50-stall house would provide for dispatching 100 engines per day if, for example, each engine was detained in the house (average) 12 hours a day. This would mean 200 moves of the table daily if each dispatchment required two moves, one in and one out, and all engines were dispatched. In other words, the table must turn once every 7.2 minutes. If a peak load period occurs in which 25 per cent of the movements are made in four hours this would require the table to turn once in every 4.8 minutes, which is about as fast as dependable operation will justify. Another consideration is the delay on account of failure of power or table which in some cases may justify one table for enginehouses with less than 50 stalls.

The size of the turntable has a considerable bearing upon the number of stalls in the house and longer tables permit more approaches without having frogs in the track at edge of table. Generally, the longer the table the less waste floor space at outer circle of house, this results from reducing the angle of stalls. The turntable deck should be wide enough to provide a walk each side with handrail protection. The turntable pit should be paved and drained. The turntable should be long enough to balance the engine when tender is empty. A deck turntable with plate girders below in pit is preferable to a through plate type with shallow pit, when the cost of construction is not greater and when drainage will permit.

There are two recognized types of turntables:

1. Balanced.
 2. Three point support.
- (a) continuous—through beams.
 - (b) non-continuous—bolted or riveted beams.

The minimum length of balanced turntable should be such that no part of the engine or tender will project beyond the edge of the table when the engine with tender empty is balanced on the table. With an adequate three-point support table no part of the engine or tender will ever project beyond the ends of the table as the balancing feature is not necessary with this type.

Cranes, Tractors and Hoists

Where heavy repairs are contemplated, an enginehouse may be equipped with overhead cranes. When the house is not equipped with a down draft exhaust system, the crane may only extend from the smoke jack to the tender but with the down draft system the crane may be extended to the outer circle wall of the house. This emphasizes one particular advantage resulting from down draft methods. Portable cranes are always useful and should be generally employed. Jib cranes are recommended, even when an overhead crane is provided, if quick material movement is desired. Without an overhead crane, jib cranes of two- or three-ton capacity, swinging on outer circle columns between working pits, are very desirable. Jib cranes at drop pits are best located on the nearest column to the pits. Tractors, where floors are suitable and specially provided, will greatly expedite the movement of material. Many commonly removed parts of modern engines have now outgrown the hand operated truck.

A joint committee of the American Railway Engineering Association and American Railway Association made a report in 1922 in part as follows: "Replies received from forty-two roads regarding cranes showed that twenty-one roads used no mechanical devices at all, seven used traveling cranes, eight used some jib cranes, eight used monorails and chain hoists and five used tractors. Six roads contemplated using traveling cranes. In general, the crane equipment is dependent upon the nature of repairs to be made, proximity of back shop, etc. A terminal handling 75 or more locomotives per day should have overhead cranes or be well supplied with jib cranes. The general feeling regarding the use of unwheeling hoists in engine houses seems to be that they will prove economical where all drivers are to be dropped and work done on them, but where no work is to be done on the wheels or on a few pairs only, the drop pits are more economical. The same remarks apply to the drop table in this case as to the unwheeling hoists."

Engine Pits and Drop Pits

A Mechanical Division committee of the American Railway Association concluded that the following characteristics of engine pits were desirable.

Distance from inner face of outer wall of engine house to inner face of pit wall.....	13 ft.
Distance inner circle columns to pit wall.....	10 ft.
Clear width of pit.....	4 ft.
Clear depth of pit below top of rail.....	2½ ft.

Jack timbers should run the full length of the pit. Pits should be crowned at the center with a gutter on each side. Drainage should be toward the turntable with a sewer grate at the extreme end of the pit. The slope for drainage should be at least 6 in. total.

The majority of roads recommend drop pits to take care of main trailer, engine truck and tender truck wheels. Pits for the engine wheels are especially desirable. Installation of pits for removing tender wheels would raise the standard of maintenance. Where Mallet engines are handled a double drop pit is recommended. Drop tables are favorably mentioned for enginehouses. A hydraulic jack is favored for drop pit work although several roads prefer air jacks since the telescoping feature requires less depth of it. There is reference to a special compressed air telescoping jack which gives reliable service. Drop pits should be located near the machine shop so that wheels can easily run in, if desired. Drop pits or drop tables are necessary in every house and the installation of a hoist does not do away with need for a drop pit when a pair of wheels must be removed.

Shops and Tool Equipments

The extent of the shop facilities will depend upon the location of the house with reference to the back shop. The machine shop should be in an annex, or adjacent to the enginehouse and generally contain only such machinery as is necessary for light or running repairs. It is not good practice to install machinery in the circle or enginehouse proper. The boiler, smith and tin shops may be located in the machine shop for small terminals, or adjacent to it for larger houses.

The following machines and facilities have been recommended by previous committees for enginehouses operating independently of back shops:

1—36-in. by 8 ft. planer	1—4-inch pipe threader
1—36-in. drill press	1—1½-in. bolt cutter
1—30-in. radial drill press	1—double punch and shear—24-in. by 36-in. metal up to 1½-in. thick
1—20-in. drill press	1—flanging clamp, 10-ft.
1—44-in. boring mill	1—800-lb. steam hammer
1—lathe for largest piston head	1—set tin shop tools
1—24-in. by 16-ft. engine lathe	2—1 man electric welders
1—16-in. by 6-ft. portable lathe	1—acetylene torch outfit
2—16-in. by 6-ft. stationary lathe	Blacksmith forges and an annealing furnace
1—28-in. D. H. crank shaper	
2—double grinders	
1—grindstone	
1—50-ton press	

It is well to locate the machine shop as far away as practicable from enginehouse gases. The American Railway Engineering Association typical terminal layout shows the machine shop extending out from the circle of the house with one enginehouse track passing through it. The blacksmith shop, foreman's office and toolroom, also storeroom, are shown in the machine shop or adjacent to it. Another alternative plan shows the engine and drop pits in the machine shop and two enginehouse tracks entering the machine shop but not passing through it. The boiler and smith shops are in the machine shop with the office and storehouse building adjacent. The boiler, tin and pipe, flue and smith shops in large terminals are best located in separate rooms or buildings adjacent to the machine shop.

Boiler Washing System

The majority of roads questioned by the committee favored equipping all enginehouse stalls with hot water wash-out and refilling facilities. A few roads prefer only one-half of the enginehouse so equipped. The general opinion is that washing boilers with hot water is at all times desirable from the standpoint of saving in time, fuel and water and reduction in fire box and flue repairs. When a house is not equipped with a washing system the blow-off steam from boilers should discharge outside the house. All hot water and steam pipes should be lagged.

A committee of the American Railway Engineering Association considered it good practice to place a set of blow-off boxes not far from the cinder pit so that locomotive boilers may be blown off a little before entering the enginehouse. This arrangement reduces the chances of clogging the blow-off line in the enginehouse, and where boiler washing plants are installed gives cleaner water for washing out and less sediment to dispose of.

Plans have recently been advanced which aim to fill boilers with steam at 100 lb. pressure or over, steam to be obtained direct from power house. It is claimed that this procedure re-

sults in much saving of time and is more economical than present practices. Your committee recommend that this matter be investigated further and report made.

Ash Handling Facilities

There is some difference of opinion as to the best location for ash handling facilities. It is generally conceded, particularly in cold climates that ash pits should be located near the enginehouse so that engines can readily enter the house, on their own steam, with fires dumped. Also the time of exposure of firebox sheets to the cold is shortened by this location. The ash pit is unquestionably the governing facility outside of the enginehouse. This is due to the length of time required for this operation. New ash pits should be designed to take care of a peak load of 25 per cent more engines than the ordinary maximum and 50 per cent more would be better.

The kind and type of ash handling facility depends entirely upon local conditions. The length and capacity of pits depends upon the maximum number of engines handled at the terminal in 24 hours. At terminals where a large number of engines must be handled quickly probably the water pit type is the best. At terminals where there is no congestion of engines the bucket conveyor type of ash pit works out satisfactorily. Water pits do not function as well in cold weather account of steam rising from the water and tendency for loaded wet ashes to freeze solid in cars. In designing water pits, care should be taken to safeguard all approaches so that men will not fall into them. A well-designed water pit will allow from four to six engines to be handled at one time and the pit capacity should be sufficient to hold ashes for several days, if necessary, account of damages to crane or lack of car supply. Water pits require a minimum number of men for the service rendered and the force may be easily adjusted to the demand. The capacity of pits may be increased readily by lengthening at either end. Length of each pit handling two engines per track should be from 1½ to 1¾ times the length of engine and tender, and length of pit handling 3 engines per track should be from 2½ to 2¾ times length of engine and tender. The type of engine selected should reflect future operating needs.

A sub-committee of the American Railway Engineering Association made a very exhaustive report on ash pits to the 1922 convention. Several paragraphs abstracted from this report are here inserted.

A new type of ash pit having many unusual features has been described recently in technical publications. This pit is located in the roundhouse and runs transversely under each stall. Engines come direct from train to stalls in house. The pit is a sloping trough 14 ft. wide at top in which a stream of water flows constantly. Ashes dropped into this trough are washed down to an outside storage pit from which they are loaded into cars with clam shell buckets. The top of the trough is level with the bottom of engine pit and when not in use is covered with a movable plate to preserve the continuity of the engine pit floor. Your committee suggests that this arrangement be investigated and reported on by a future committee.

Ash pit design obviously depends upon the number of engines handled. A check of over 7,000 fire cleanings showed 1.41 cu. yd. of ashes removed per engine, with a good grade of coal. Your committee recommends from 2 to 3 cu. yd. of ashes per engine for average storage capacity. Where local data has not been secured it is recommended to design pit capacity on basis of engine standing 45 minutes on pit for cleaning operation. This includes two men working 30 minutes.

Coaling Station, Sand Storage and Water Cranes

Coaling stations may be of the modern mechanical type or the older gravity tipple. The type selected usually depends upon the number of engines handled, the number of tracks available for coaling engines and the kind of coal used. Station capacity should be at least 24 hours' supply and better 48 hours, for maximum demand. The coal storage bins should be made self-cleaning as much as possible by proper sloping of forces. Gravity tipple outlet fixtures may be of the under-cut or over-cut type. Preference is shown for the over-cut fixture as it seems to provide more even mixing of coal delivered.

Mechanical coaling stations should be of the transverse type and a station serving several tracks is preferable to the longitudinal type because it facilitates engine movement to and from the sta-

tion. When it is necessary to deliver coal to two or more tracks it is best to install a mechanical type of station. Loaded coal car tracks should have a down grade toward the track hopper to permit easy feeding of cars. The receiving hopper must be long and wide enough to handle a complete car and provide sufficient room for unloading and handling coal. The hopper should be protected from the weather. It is not good practice to have a steel car chute too close to ash pits on account of fumes from wet ashes corroding the steel. A good many modern mechanical stations are built of concrete, with usual bucket type conveyor. Under certain conditions a belt conveyor has been found satisfactory and economical. A coal measuring or weighing device is recommended for all coaling stations.

A longitudinal coaling station designed recently and described in technical papers shows coal dumped into a pit below the ground level. A clam shell with traveling crane lifts the coal to gravity chutes which deliver direct to tenders. This type of coaling station has a number of new features which may prove superior in operation or economy to other types. Your committee suggests that this arrangement be studied and reported on by a future committee.

Sanding facilities are usually found in common with coal chute so that sanding may be accomplished while taking coal. Also in small terminals the duties of men operating tipple and sand facilities may be combined. Sand should be dumped from road cars into a pit beneath the track or trestle. Storage capacity of green sand should be sufficient for several months' supply; a winter's supply should be provided in cold climates. Modern sanding facilities are recommended for all large terminals. One well-known arrangement provides for dumping wet sand through a hopper to an underground storage pit, from there it is elevated in conveyor buckets to dryers which in turn discharge dry sand by gravity into tanks. These tanks are charged with air which forces dry sand to other tanks high enough to discharge by gravity to engine boxes. Smaller terminals may be equipped with dryers preferably of the stove type, on ground level which discharge dry sifted sand by gravity into underground tanks from which sand is forced by air to overhead gravity tanks similar to mechanical arrangement just described.

The location and number of water cranes or columns depends upon the importance of the terminal and local conditions in the terminal and yard. Water supply for yard engines should be especially considered and water storage tanks should always be of very liberal proportions. No water crane should be located where the overflow will freeze on switches. Suitable sewer gratings should always be furnished to carry away surplus water. Water columns should also be located near the entrance to the terminal and water should be equally available for inbound and outbound engines. Engines taking water should not block the movement of other engines.

Inspection Pits and Washing Platform

A number of roads have found inspection pits to be an important addition to the terminal. In cold climates pits should be covered with a protection shed. Pits should be connected by transverse tunnels with steps up to ground level in the clear. The inspector's office should have a pneumatic tube connection with enginehouse foreman's office to expedite writing up and issuing orders for making repairs necessary. Track space for two times their capacity should be allowed front and rear for power waiting for and leaving the inspection pits. Inspection pits are best made of concrete with floor crowned in the middle for drainage. Sufficient sockets for portable and fixed lights should be provided. The inspection pit is really the entrance or beginning of the terminal. Here the crews are usually released and it is a convenient location for locker, wash and toilet rooms for crews, also the inspector's office.

Buildings and Offices

The location of the wash platform is subject to considerable difference of opinion. In some cases it is thought best to wash engines first on entering the terminal and before inspection. Others prefer to wash last, after engines leave ash pits and just before entering house. Some roads, particularly in cold climates, prefer the washing facilities in the enginehouse and one stall is occupied for this purpose. The wash platform should be arranged so that operators can climb up easily when washing upper parts of engines and tenders.

The officer in charge of enginehouse should have an office adjacent to the house. This building should provide rooms for usual clerks and dispatchers. Suitable locker and wash rooms and toilets should be provided for all enginehouse employees, also an ample supply of drinking water conveniently located. A proper telephone connection for all offices at the terminal is very important. This may be handled through a private branch exchange.

The supply house should be so located that supplies may be taken from incoming engines, checked into house and out again to out-going engines. The location depends upon the general design of the terminal and should be so convenient as to cause no delay to arriving and departing engines. At small terminals the supply house, if large enough, may be used jointly with other houses or offices which may be located nearby.

Light repair sheds are not in general use. A considerable number of engines do not have to go into the house and these may be very readily cared for in the repair shed. Shed should be located near the machine shop. Light repair sheds provide cheap floor space for tightening and testing engines and thus conserve the high-priced floor space in the enginehouse for heavier repairs. It is recommended that more data be obtained relative to the economy and usefulness of this facility.

Storehouse and Oil House

The storehouse and its facilities should be centrally located, preferably close to enginehouse and machine shop. Walls should have plenty of windows and material handling should be expedited by suitable roadways, platforms and racks. The oil and storehouses should be of fireproof construction. Storehouse should be placed so that men will not have to cross enginehouse leads to get materials.

Oil requirements at large terminals necessitate a separate oil house with attendant, located conveniently to enginehouse and machine shop. At a terminal where oil requirements are light the oil house may be made a part of the storehouse but separated from it by fire walls. In any case, the oil house should be adjacent to storehouse.

Exhibit B—Power Houses

The following is a summary of previous reports of the committee on Modernization of Stationary Boiler plants, condensed and brought up to date.

Power House Building

LOCATION

The power plant should be located centrally with respect to distribution of live steam (especially to roundhouse blower lines); exhaust steam for heating; electric current; air and water. If plant is, or may be operated, condensing the location with respect to source of circulating water and disposal of hot well discharge should be considered. Also plant should be readily accessible for switching and storage of fuel and cinder cars.

CONSTRUCTION

Frame. Wood frame and wood roof trusses are desirable for small plants up to 300 hp. or temporary plants. Steel frames and trusses have the advantage of permanency, and structural possibilities, such as furnishing support for coal bins, ash conveyors, traveling cranes and piping.

Walls. Wood or galvanized iron walls are advisable only in small or temporary installations. Brick or reinforced concrete are superior and cost less for maintenance.

Floors. Concrete or similar floors are best. The floors should not be connected to engine foundations and should be provided with suitable drains. Whenever possible a basement should be provided below the engine room floor to accommodate exhaust steam and other pipe lines with sufficient head room for men to work. Often it is desirable to make the basement floor of one concrete slab reinforced about two feet thick for supporting machine foundations.

Roof. It is advisable to have the roof of fireproof construction, especially over boiler room.

Windows. Ample windows to be provided for ventilation and light. Steel sash are preferable.

Doors. The doors should be conveniently located and of sufficient size to move machines in and out the building.

Ventilation. Natural draft or induced draft ventilation should be installed, especially in engine room where electric machinery is in operation, and must be kept cool.

Cranes. It is advisable to install hand-operated traveling cranes over the equipment in the engine room for taking out crank shafts, pistons, etc.

Power House Equipment

BOILERS

Type. The following types of boilers are generally employed in railway power plants: (1) Locomotive type. (2) Scotch Marine type. (3) Horizontal return tubular. (4) Water tube.

Locomotive type boilers have an advantage in small railway power plants, as these boilers are often obtained from dismantled locomotives and the cost of installation is small.

Horizontal return tubular boilers are also comparatively less expensive, especially the installation. The advisable limiting size of locomotive and horizontal return tubular boilers is 150 hp., and the highest boiler pressure 150 lb. When more than six locomotives or return tubular boilers are in one installation it is then desirable to consider water tube boilers of larger capacity per unit. For the relative efficiencies of locomotive, return tubular and water tube, see Table 1.

TABLE I—COMPARATIVE EFFICIENCIES OF LOCOMOTIVE RETURN TUBULAR AND WATER TUBE BOILERS HAND FIRED AND STOKER FIRED

	Lb. of water evaporated per lb. of combustible from and at 212 deg. F.	Hand fired	Stoker fired
Locomotive type	4 to 6.5		
Return tubular type.....	5.5 to 9	6 to 10	
Water tube type.....	7 to 10.5	8 to 12	

Settings. The foundations of boilers should be made firm by proper footings to prevent settling and cracking of the side walls and opening up of pipe joints as well as the deterioration of interior brick wall and distortion of the boiler itself.

The settings of water tube boilers vary with the type and conditions of service and it is recommended to follow setting plans provided by the manufacturer.

Stack. Stacks may be of steel, brick or concrete. The comparative cost for initial installation and per annual maintenance, based on 1922 figures, are shown in Tables II and III respectively.

TABLE II—STACKS COSTS PER BOILER HORSE POWER

	200 Hp.	400 Hp.	600 Hp.	800 Hp.
Steel	\$600	\$1,500	\$2,100	\$2,800
Brick	2,700	2,900	3,100	3,500
Concrete	2,600	2,800	3,200	3,600

TABLE III—MAINTENANCE AND DEPRECIATION COSTS OF STACKS PER YEAR

	200 Hp.	400 Hp.	600 Hp.	800 Hp.
Steel	\$120	\$240	....	....
Brick	82	90	\$95	\$100
Concrete	65	72	80	87

Stokers. With hand firing and hand ash disposal one fireman can efficiently attend 200 boiler horsepower or 500 boiler horsepower if he shovels coal only. With stokers, overhead coal bunkers and mechanical ash conveyors one man can look after 1,000 to 4,000 boiler horsepower. Therefore, with all factors considered, such as reduction in boiler room force, greater capacity of boilers, interest and depreciation on investment, etc., it is believed that plants having 1,000 hp. and over should have stoker feed boilers and under certain conditions profit may be shown with stoker feed boilers in less than 1,000 hp. The type of stoker to be used depends upon fuel available and the method of conveying same in the power plant. Following are the types of stokers in general use:

1. Hand fired and hand operated. These give a more even distribution of the fuel bed but do not eliminate hand firing.

2. Traveling chain grate with natural draft. This type of stoker is best fitted for burning small sizes of free burning bituminous coals, especially coals with high ash content. The capacity of the boiler is limited to the amount of fuel which can be burned on the grate with natural draft afforded.

3. Traveling chain grates with forced draft. This type of stoker was designed especially for burning coals of high fixed carbon such as anthracite, slack and coke breeze and has proven successful in this field. Is now being tried more or less successfully

with certain bituminous coals. The forced draft gives this type of stoker greater capacity than the natural draft stoker, also enables it more effectively to take care of sudden fluctuating loads.

4. Over feed step grates. This type of stoker is designed for both natural draft and forced draft and is used mostly with free burning bituminous coals.

5. Underfeed stokers with forced draft. These stokers are best adapted for burning coking bituminous coals of all grades and sizes. The advantage of the forced draft with this stoker is the same as with forced draft chain grate.

6. Pulverized fuel. At present pulverized fuel finds its field in plants exceeding 1,000 developed boiler horsepower. Low grade fuel has been burned and high boiler efficiencies obtained. The process of pulverizing is being perfected and cost reduced. The relative cost of operating pulverized fuel installations and stoker installations depends largely upon local conditions.

Coal and Ash Handling Apparatus. Coal should be placed in a boiler room and on the grates and ashes disposed of at the least cost. This usually means reducing the hand labor by providing mechanical coal and ash handling equipment. The following systems are in general use:

1. A trestle over a coal bin in front of hand fired boilers, the coal being dropped into the bin from dump coal cars.

2. Continuous conveyors such as: Spiral screw, scrapers, aprons and buckets, overlapping pivoting buckets and endless belts.

3. Hoists with car or a skip hoist.

4. Clam shell operated by a locomotive crane.

5. Steam ejector for ashes suitable for small plants.

Feed Water Heaters. It is very advisable to use feed water heaters in plants of all sizes. The feeding of cold water by injector or pumps into the boilers is detrimental to the boilers and also uneconomical. There is a saving of 1 per cent in fuel for each 11 degrees feed water heated before it enters the boilers. To insure efficient heating of the water and reserve storage capacity, the heater should be of ample size. In plants where exhaust steam is used for heating the condensate should be returned to the feed water heater. In such cases it is often advisable to install an auxiliary reservoir or "make up tank" above the heater in order that the heater may not be overflowed when a large quantity of condensate is returned during the short period of time. In large power plants a recording meter on the heater is a convenience in determining the load carried by the boilers. The open type feed water heater is most satisfactory for railway power plants.

Feed water pumps. Feed water pumps should be of ample size and at least two pumps (duplicate units) provided. Many railroads find outside packed plunger type to be the most satisfactory on account of convenience in maintaining the packing.

ENGINE ROOM EQUIPMENT

Steam Engines. Due to the fact that at the majority of shops and roundhouses, exhaust steam is used for heating buildings and also because steam boilers must be maintained to furnish live steam to the roundhouse steam blower line the prime movers are mostly steam driven. In a few cases it has been found advantageous and economical to install gas or oil engines, but so long as steam locomotives must be operated the steam power plant will likely predominate. The principal classes of steam driven prime movers are as follows:

1. Reciprocating engines of several types.

2. Steam turbines.

The determination of what particular kind of steam engine shall be employed requires careful analysis, as local conditions largely govern; such as floor space available, amount of exhaust steam needed for heat, required size of unit, type of generator and whether plant is to be operated condensing or non-condensing. In general it may be said that in units up to 250 hp. operating with exhaust steam used for heating, reciprocating engines are the most desirable. If during the season when steam heat is not required, and at the same time fuel must be conserved, uniflow engines may be considered. Also if circulating water is available engines may be run condensing. In units above 250 hp., except in special cases, steam turbines are preferable. In order to secure reasonable economy from steam turbines they must be run condensing and it is necessary to take this into consideration.

As to maintenance, this largely depends upon local conditions, but in general steam turbines require less maintenance than reciprocating engines, but when repairs are necessary it generally requires the service of the specialist not always available on railroad organ-

izations. The railway shop machinist is usually capable of making repairs to the reciprocating engines.

Air Compressors. The air compressor equipment for the shop terminal should be of ample capacity. Air tools will not operate efficiently at less than 100 lb. pressure. The intake pipe opening should be at least fifteen feet above the ground and protected so far as possible against dirt, dust and moisture entering the compressor. Ample air reservoir capacity should be provided and air lines should be protected against freezing and accumulation of moisture. In some cases it may be advisable to install after coolers to relieve the air of suspended moisture.

Pumping Units. It is very advisable to have the pumping units accessible to the other engine room equipment, especially if they are to be depended upon for fire protection. Fly wheel pumping engines are very satisfactory units.

POWER HOUSE PIPING

The design and installation of power house piping requires care and the following features demand particular attention: (a) Sizes, (b) Provisions for expansion in steam lines, (c) Provisions for proper drainage to prevent accumulation of water with resulting water hammers and damage, (d) The use of good material both as to pipe, fittings and packing. A failure in the piping due to poor material will cost many times what would be saved by the use of such material, (e) All cutout valves for boilers and steam driven units should be conveniently located and within reach of the power house attendants; if necessary, runways over boilers with shops, etc., should be provided to enable the attendants to reach all valves, (f) Pipes and fittings should be so located that all parts are readily accessible for repairing and renewing; avoiding, so far as possible, all trenches and similar unhandy arrangements.

POWER PLANT EFFICIENCY

Notwithstanding that a power plant may be carefully designed with respect to building arrangement and equipment, it will not accomplish what was expected in output or cost per unit of output unless the equipment is properly operated and maintained and also economies and efficiencies sought after. The operating engineer should be an experienced mechanic capable of repairing and maintaining the equipment under his charge. Cleanliness of machinery, floors, walls, etc., about the engine room and boiler room indicates, as a rule, a careful operating engineer and one who maintains his machinery in the same good order. The maintenance of all equipment is of the utmost importance as a failure may occur which will cripple the roundhouse terminal and perhaps cause a shutdown of the shops.

In addition to the proper maintenance of equipment, an effort should be made to secure the output at as low a cost as possible by locating and correcting the inefficiencies of the plant. The losses occur in both the boiler and engine room and the correction of many of them is not beyond the ability of the usual chief engineer or his immediate supervisor. The following are among the more important causes of:

Boiler Room Losses

Excess of Moisture in the coal caused by too much water to "wet down the coal."

Incomplete Combustion. (a) Due to insufficient grate area or grates being clogged up. (b) Unburned coal escaping through the grates into the ash pit. (c) Insufficient air supply resulting in formation of smoke and unburned gases, such as carbon monoxide. (d) The deterioration of boiler bridge walls or baffles being burned out and boiler gases short circuited.

Excess Air During Combustion. In large plants where efficient help is employed the use of stack temperature recording instruments as well as carbon dioxide recorders are helpful in determining the processes of combustion, also draft gages may be used in determining this and other losses.

Air Leaks in Boiler Settings. Cracks in boiler settings and loose clean cut doors should not be permitted, as air infiltration cuts down furnace efficiency.

Cold Feed Water. Boilers should be fed with pumps instead of injectors and water heated in a feed water heater which should be kept clean and in working order.

Scale on Boiler Tubes. Scale $\frac{1}{8}$ inch thick on boiler tubes and shell causes heat losses up to 10 per cent. Also excessive scale deposits cause rapid deterioration of tubes and boilers and make

for excessive repairs. It is advisable to treat very hard waters to lessen their content of scale forming salts.

Soot on Boiler Tubes. Soot is an excellent non-conductor of heat and an accumulation of soot quickly cuts down boiler efficiency. Permanent soot blowing apparatus is now usually installed with all water tube boilers and is also finding favor in smaller installations of other types of boilers.

Engine Room Losses

Steam, Air and Water Leaks. Unless steam, air and water leaks are carefully watched they will be the source of great expense. With coal costing \$4.00 per ton and water at 8 cents per one thousand gallons the following table shows loss per month by steam, air and water leaks:

Size of the leak or sum of the several leaks	COST OF STEAM LEAKS			
	60 lb.	120 lb.	150 lb.	200 lb.
$\frac{1}{8}$ in. diameter	\$2.98	\$5.26	\$6.44	\$8.24
$\frac{1}{4}$ in. diameter	11.86	21.02	35.74	33.00
$\frac{3}{8}$ in. diameter	57.46	84.04	102.96	132.02
$\frac{1}{2}$ in. diameter	189.90	336.10	411.86	528.08
$\frac{5}{8}$ in. diameter	427.50	756.10	926.50	1,187.96
1 in. diameter	759.62	1,344.44	1,647.44	2,112.34

Size of the leak or sum of the several leaks	COST OF AIR LEAKS	
	100 lb. per sq. in.	Cost of leak per month—air pressure
$\frac{1}{8}$ in. diameter	\$5.78
$\frac{1}{4}$ in. diameter	23.18
$\frac{3}{8}$ in. diameter	92.72
$\frac{1}{2}$ in. diameter	370.90
$\frac{5}{8}$ in. diameter	835.00
1 in. diameter	1,483.64

Size of the leak or sum of the several leaks	COST OF WATER LEAKS	
	100 lb. per sq. in.	Cost of leak per month—air pressure
$\frac{1}{8}$ in. diameter	\$12.00
$\frac{1}{4}$ in. diameter	48.00
$\frac{3}{8}$ in. diameter	192.00
$\frac{1}{2}$ in. diameter	768.00
$\frac{5}{8}$ in. diameter	822.00
1 in. diameter	3,072.00

Loss from Radiation. All steam pipes as well as cylinders and valve chests on steam operated machines should be well insulated with suitable coverings of which there are a number on the market. For railway power plants consideration should be given to fireproof coverings reasonably unaffected by moisture and steam, with a composition that will resist an ordinary amount of handling as well as vibration.

Steam Losses in Reciprocating Engines. Due to steam leaking by valves and pistons, these losses are obvious and can be and should be corrected by the operating force.

Steam Losses in Steam Turbines on account of worn blades and nozzles can be corrected by the operating forces or by experts.

Losses in Reciprocating Steam Engines and Air Compressors on account of incorrect valve settings can be corrected by the operating engineer who should be provided with steam engine indicators, etc.

Losses in Pumping Machinery on account of slippage by water pistons and valves can be corrected by the operating engineer.

Power Transmission

Power transmission in railway shops resolves itself into the following classes:

TRANSMISSION BY BELTING AND LINE SHAFTING

This is used in small shops where no electric energy is available, or in group drives in large shops using steam engines in the former and electric motors in the latter. Oak tanned leather belting is preferable; cast iron split pulleys are more desirable than wood split or steel split pulleys; the usual kind of shafting employed is cold rolled steel.

Hangers with roller bearings are in general use and very satisfactory as they reduce friction load. The building roof trusses should be capable of supporting, at least, 1,600 lb. concentrated load at intervals of eight feet for the shafting, etc. Tight and loose pulleys in many cases have been found more desirable than friction clutches on countershafts.

ELECTRIC TRANSMISSION

Electric motors are used on large machines and also on machines which are isolated or cannot be properly driven by belt, or

machines which are located in bays served by an overhead traveling crane. Direct current is preferable for operating electric traveling cranes of large capacity, various speed motors on machine tools and reversing motors on metal planers. Alternating current has much the advantage in facility of transmission.

Motor Installations. Where small power plants are involved it is the practice to install wound rotor slip ring type induction motors in sizes 10 hp, and larger, to avoid the disturbance resulting from the starting of the squirrel cage type. Motor wiring should be in rigid iron conduit and safety switches used with automatically protected manual starting equipment is the general rule.

Portable Motor Drives. The use of portable motor driven arc welders and machine tools is increasing rapidly. In enginehouses outlets may be provided at alternate stalls, placing them on the wall of the outer circle. In the shop buildings outlets may be placed as demanded by local conditions. The outlet is a combined safety switch and plugging receptacle so interlocked that the plug cannot be inserted or removed while the switch is closed. A contact is provided in the receptacle for grounding the frame of the motor through the steel armor of the flexible connection. The flexible connection between the plug and motor is kept as short as possible.

Portable Electric Rivet Heaters. These are being introduced and are difficult to handle on a small plant, on account of the fluctuations and comparatively heavy demand. Outlets are provided as demanded by local conditions, the same type of receptacle being used as for portable motors, but wired on a separate circuit, single phase, two wire circuits having proved most economical under present conditions. It is understood that development is progressing on a resistance type heater. Receptacles are available up to 200 amperes, 500 volts a-c, with greater capacities in prospect.

Traveling Cranes. Bare copper trolley wires are used on the smaller sizes, but in recent installations of 250 and 150 ton cranes T-rail contact conductors have been used. Feeders are provided to keep the drop of potential at any point on the runway within such limits that the crane speed will not be materially reduced under maximum operating demands. A rather unusual feature is the guarding of the main contact conductors to prevent accidental shock to men working on the crane runway structure. Isolation by elevation is usually considered a sufficient guard, but we have had several serious accidents, particularly in enginehouses, to window washers and men on top of locomotives.

COMPRESSED AIR TRANSMISSION

Compressed air is used mostly on portable tools. The average pressure in the air mains is usually 110 lb. per sq. in.

Piping, Lighting and Heating

GENERAL PIPING

All pipe lines containing steam, air or gas should be placed above ground on support wherever possible. Also suitable runways should be provided inside of buildings for overhead pipes. These runways should consist of suitable steel stringers with grating thereon to prevent accumulation of dust and persons slipping when making repairs to pipe lines.

Cutout valves should be placed on all pipe lines which enter buildings. These to be located not nearer than 20 ft. on the outside of the building and arranged with chain wheels, if overhead, for shutting off the lines in case of fire.

Expansion of pipe lines should be provided for by the use of "U" bends.

For fire protection inside of building, hose reels are usually employed. Where the use of hose reels are required on the outside of building, such as in car repair yards, or transportation yards, a suitable metal hose should be built with the roof well insulated to prevent the heat from deteriorating the rubber hose. Pipe lines serving fire hydrants should not be placed close to buildings and fire hydrants should be situated to give most ready means of protecting buildings.

NATURAL LIGHTING

In old shops sufficient attention was not given to securing adequate daylight illumination. This was somewhat difficult on account of the building construction then used; but with the steel frame construction it is now possible to give large wall areas to glass sash which serves for both light and ventilation. Also of late satisfactory skylights such as the "V" shaped skylights have

been brought out that give light without glare, ventilation and freedom from condensation and dripping of moisture.

ELECTRIC LIGHTING

General Wiring. is installed in rigid iron conduit, with a 30 per cent Para insulation for rubber covered wire.

Enginehouses. Different methods of illuminating enginehouses are used, depending upon the construction of the building, and to a certain extent upon the preference of the local operating people. A system generally used is the installation of roundhouse reflectors, especially designed and marketed for enginehouse use.

These are mounted about eight feet from the floor, three being used per stall, the arrangement depending upon the location of building columns. A white enameled reflector with a plain glass door has proved most satisfactory. Ease of cleaning and reduction of bulb theft and breakage, as well as good distribution of light, result from this installation.

Plugging circuits for portable electric light extensions are placed on the building columns. In connection with the use of these portable extensions particular attention is called to the necessity of properly safeguarding the users by providing a heavy pattern portable lamp guard, with socket recessed in a wood handle, with portable cord and as rapidly as practicable use polarized caps to insure connecting the screw shell of the socket to the grounded wire of the circuit. All drop cord and extensions should be maintained in safe condition.

Shop Buildings. For shop buildings general illumination from overhead enameled steel reflector units, spaced for uniform intensity, supplemented by local illumination where the nature of the work requires local lighting, is preferred.

Turntable, Cinder Pits, Etc. The tendency is to use flood lighting where practicable, though illumination by units suspended from poles or messengers is quite common and usually satisfactory.

Yard Lighting. Shop yard lighting is usually accomplished by units mounted on poles and flood lighting. Have one very satisfactory coach yard flood lighting installation. Caution should be exercised in laying out flood lighting to avoid glare and shadows.

HEATING WITH STOVES

The heating of roundhouses or shops by stoves should not be considered except in very mild climates and where oil or gas is available. Heat from stoves does not fill the entire building and stoves are expensive and dirty to maintain, also constitute a serious fire hazard.

STEAM HEAT

General. In general heating by steam is the most satisfactory, using exhaust steam wherever possible and supplementing by live steam if necessary. Practically there is about 3.4 per cent as much heat in exhaust steam as there is in live steam. The heat is given out by two systems, direct radiation and indirect radiation.

Direct radiation. In this system the pipe or radiators are placed along walls or in engine pits where the cold air accumulates or passes. The condensed steam wherever possible should be returned to the powerhouse.

Indirect radiation. In this system a current of air is blown over a nest of pipes by means of fan blowers and the hot air distributed throughout the building by ducts, the ducts discharging the hot air where it will meet the incoming cold air.

Exhibit C—Car Shops

A tentative shop layout embodying general features in such detail as was deemed immediately essential, together with general observations on the subject, were submitted to the Association in Circular S-111-132 at the 1920 Annual Meeting. A shop of four units A—B—C and D was presented; also certain other fundamentals were recommended, such as track spacing, crane capacity, standard gage industrial track and the height under girder beam of crane, etc. This plan was worked out with the idea of consolidating facilities at large interchange centers, however it is beyond the average requirements of most any of the railroads with the possible exception of the very largest. Each unit submitted provides for a capacity of 25 cars per day and the expansion program so mapped out to facilitate expansion until the ultimate capacity of 100 cars per day is reached. No definite conclusions have been drawn as to the construction of the buildings, this being in a large measure dependent upon the location, the dif-

ferent type of construction varying for certain localities to such an extent as not to permit of any recommended practice.

The consensus of opinion denotes a preference of the more or less square type of building in lieu of the longitudinal shape since it permits less congestion, particularly where the progressive system of repairs cannot be followed entirely. In scheduling equipment through shops, not very much can be accomplished in mine run of cars, but must be selected in series, or practically the same class of equipment. The cost of moving and the damage created in getting cars to the shops should also be given serious consideration.

Steel car shops should be located where the cars accumulate, or at the unloading point, or at the point where they are to be loaded. At the Great Lakes where most of the steel cars are used, the shop should be provided near the unloading points on the lake. On roads that have no ore, in the reverse movement, the shops should be located in the mine districts, or on a division leading to the mine. Wood car shops should be located where the bad orders accumulate. It does not pay to haul a wood car the entire length of the road for a roof or end, some side sheathing or floor. For that reason a railroad with 20,000 to 40,000 cars should not need more than two first class shops. Cars going to these shops would be cars requiring extremely heavy repairs.

The question of machine tools as reflected in the report referred to above is more a suggestion than a recommendation and the committee feels that this subject be given careful consideration in the near future, particularly the method of heating rivets, whether electrically, oil or coke and the method of removing rivets, whether arc, gas or busters.

Exhibit D—Locomotive Shops

The committee finds that very little data has been collected on the design of locomotive shops by previous committees and about the only information available is found in technical publications.

The committee feels that the time available to collect data and submit a comprehensive report is too short and they recommend that this important subject be given consideration by future committees.

Power House Equipment

In general this part of the report is identical with Exhibit B, except for the following additions:

BOILERS

Oil and Gas Fuels. The use of oil and gas as a fuel is increasing, particularly in the vicinity of oil and gas fields. Also the use of oil has extended beyond the limits of fields of production to territories where (1) a suitable grade of coal does not exist, (2) where coal is comparatively higher in price than oil, or (3) where lack of coal storage facilities, inadequate supply, or other local conditions influence. The relative economy of a coal and oil burning installation depends upon the heating values of the coal and oil to be burned; cost of same laid down at the plant and local conditions as to boiler settings, etc. In determining the advisability of burning oil the following factors are taken into consideration in addition to comparative costs:

1. Reduction in boiler room labor.
2. Elimination of coal and ash handling.
3. Cleanliness about the plant.
4. Close regulation of firing.

In general, the oil burning installation consists of the following:

Storage. The oil is delivered in tank cars which are drained into an unloading trough, or direct by pipe connection to a storage reservoir; if gravity is not sufficient to drain, pumping must be resorted to. The reservoir may have capacity of from 10,000 gal. to 50,000 bbls. or more. The oil flows by gravity through pipe lines suitably placed and heated from the main reservoir to an auxiliary reservoir outside the power plant.

Pumps. Oil is fed to burners by means of steam operated pumps operating on governors usually set at from 20 lbs to 60 lbs. oil pressure. The pumps should be of the Duplex type and provided with air chambers so that the oil flow will be steady.

Burners. Several types of burners are employed: (a) "Outside mix"—from which the oil flows out of burner on to a jet of steam which conveys it into the combustion chamber. This type of burner is particularly adapted to very heavy oils; (b) "Inside

mix" or atomizing. The oil and steam are intimately mixed inside of this type of burner by means of baffles or spirals which very finely atomize the oil and reduce it to a vapor. This burner is especially adapted to light grades of oil; (c) "Mechanical mix burner." The oil is atomized in this type of burner by various imposed mechanisms which break up the oil which is supplied at a very high pressure. Such burners require special draft conditions.

Settings. As a rule oil burning boiler settings deteriorate much reservoir; if gravity is not sufficient to drain-pumping must be exercised in placing the settings and in selecting the materials. It is necessary that sufficient combustion chamber space be provided otherwise the combustion chamber will take on the character of a retort and quickly melt down the settings and injure the boiler. The kind of settings varies with the type of boilers employed.

Regulation and economy. To get the best results from oil burners they must be regulated to give a clear fire and without too little or too much air. There are automatic regulators on the market which have been successfully used.

ENGINE ROOM EQUIPMENT

Reciprocating engines of several types. The determination of what particular kind of steam engine shall be employed requires careful analysis as local conditions largely govern; such as floor space available, amount of exhaust steam needed for heat, required sizes of unit type of generator and whether plant is to be operated condensing or non-condensing. In general it may be said that in units up to 250 hp. operating with exhaust steam used for heating, reciprocating engines are the most desirable. If during the season when steam heat is not required and at the same time fuel must be conserved uniflow engines may be considered. Also if circulating water is available engines may be run condensing.

Steam turbines. In units of about 250 hp. except in special cases steam turbines are preferable. It will be noted from the table that in order to secure reasonable economy from steam turbines they must be run condensing and it is necessary to take this into consideration.

As to maintenance, this largely depends upon local conditions, but in general steam turbines require less maintenance than reciprocating engines, but when repairs are necessary it generally requires the service of the specialist not always available in railroad organizations. The railway shop machinist is usually capable of making repairs to the reciprocating engines.

POWER HOUSE PIPING

Insulation should be placed on pipes and fittings carrying steam, the type of insulation and amount varying with the temperature and construction employed. All covering should be protected from weather and damage and on outside pipe lines the joints in the lagging should be "buttered" and a metal jacket applied which should be kept well painted.

GENERAL PIPING

For fire protection inside of building, hose reels are usually employed. Where the use of hose reels are required on the outside of building, such as, in car repair yards, or transportation yards, a suitable metal hose house should be built with the roof well insulated to prevent the heat from deteriorating the rubber hose. Pipe lines serving fire hydrants should not be placed close to buildings, and fire hydrants should be situated to give most ready means of protecting buildings.

HEATING

Hot Water Circulating System. In this system the exhaust steam (supplemented by live steam if necessary) heats water in a specially designed heater in the power house and is circulated through the shops by circulating pumps. The heat may be supplied to the buildings through direct or indirect radiation as in the case of steam heat. It is claimed that this system offers a superior regulation of the heat supply.

The report is signed by A. R. Ayers (Chairman) N. Y., C. & St. L.; F. W. Hawkins, Pennsylvania System; I. S. Downing, C. C. C. & St. L.; B. P. Phelps, A. T. & S. F.; and Henry Gardner, B. & O.

REPRESENTATIVES of the federated shopcrafts in the New York Central, having asked for a general increase in pay, are holding protracted conferences in New York City with officers of the road.

New Burlington Locomotive Shop at Denver

\$2,500,000 Project Will Employ 750 Men—Will Turn Out
200 Classified and 50 Running Repairs a Year

By A. H. Ostberg

Mechanical Engineer, Valuation Department, C. B. & Q.

AFTER A THOROUGH INVESTIGATION, taking into consideration the present shop facilities for handling heavy locomotive repairs as a whole, the large increase in number of locomotives acquired during recent years, locomotives on order and an increase in business requiring the intense use of the locomotives from a service standpoint, it was decided to build a locomotive repair shop capable at the outset of taking care of 200 classified repairs and 50 running repairs per year.

The next important step considered was the geographical location of this shop. About 63 per cent of the total locomotives are assigned on the lines east of the Missouri River. Our locomotive repair facilities on this side of the river were materially strengthened when in 1917 we built at West Burlington, Iowa, a new machine and erecting shop and other improvements capable of an ultimate output of 50 locomotives a month.

On the lines west of the Missouri River, about 37 per cent of the total number of locomotives are assigned. In 1910, extensive locomotive repair shops were constructed at Havelock, Nebr., and no other important locomotive shop improvements have been installed since then, notwithstanding the fact that the percentage of increase in locomotives assigned to the lines west has been the same as the increase on the lines east. It was, therefore, concluded that the new shop facilities should be placed somewhere on the lines west.

A location was desirable which would facilitate the movement of locomotives to be shopped with the least possible average haul, taking into consideration the fact that some engines would have to be towed in both directions while others might be able to go under steam. The number of coal and oil-burning engines to be repaired and their relative division assignments were also important factors in deciding on the location. Accessibility to the labor and material markets, climatic as well as living conditions, and water conditions were also taken into consideration.

Denver, Colo., at the extreme western end of the railroad, was finally selected. The shop site covers 280 acres, and is located about 2½ miles north of the Union Station. It has an ideal location and can easily be reached from the city by electric cars, and is easily accessible both from the Burlington and Colorado & Southern.

The improvements consist of the following:

Machine and erecting shop	240 ft. by 506 ft.
Boiler shop	130 ft. by 306 ft.
Blacksmith shop	88 ft. by 198 ft.
Power house	89 ft. by 128 ft.
Storehouse and office (3 story)	80 ft. by 160 ft.
Oil house	25 ft. by 40 ft.
Oxweld generator house	20 ft. by 50 ft.
Yard Crane Runway	100 ft. by 577 ft.
Casting platform with crane	84 ft. by 272 ft.
Lye vat, deep wells, stand pipe, electric substations, etc.	

In planning the relative locations of the buildings, the importance of minimum handling of materials to and from shops was carefully considered. The shop and storehouse yard cranes overlap, allowing for interchange of material. Necessary concrete runways and ramps are provided for easy and quick handling of motor trucks. The buildings are located and built so that ample future enlargements can easily be made without interfering with the operation and, while at present the facilities are only to be used for locomotive repairs, ample space is allowed for possible freight and passenger car repair facilities.

In a facility of this kind the proper selection and location of tools and machinery is of great importance. In placing the machinery, a careful study should be made of the major operations to be performed on each individual tool. With this information at hand, the tools may be placed in groups or departments so that

the work may be done with the least possible back movement in routing through the shop.

Machine and Erecting Shop

The machine and erecting shop is 240 ft. wide by 506 ft. long, divided into three bays. The erecting shop in the center is 100 ft. wide and the machine shop on each side is 70 ft. wide.

The building frame is all structural steel, supported on heavy concrete piers with a concrete curtain wall up to the windows and tile above. It has concrete floors throughout. The windows are wired glass in steel sash, which together with the monitor sash, give perfect light to all parts of the shop. The shop is heated by the blast system from fan rooms located in buildings adjacent to the center of the east and west walls through underground concrete ducts to registers located at alternate columns. Adequate toilet and locker room facilities are also provided in the building on the west wall. It is lighted by high-powered Mazda lamps suspended from the ceiling, sufficient for night work when necessary.

A system of crane signals is installed throughout the shops facilitating the movement of the cranes.

The shop is of the longitudinal type with three pit tracks 30 ft. from center to center, extending the full length of the erecting shop. These tracks will accommodate about 35 locomotives at one time. The erecting shop is served by two 125-ton cranes on the upper crane runway, and one 15-ton crane on the lower runway. The large cranes are provided with 15-ton auxiliary hoists.

The distance from the erecting shop floor to the roof trusses is 50 ft.

The east machine bay will be used for heavy work and is served by two 15-ton traveling cranes and 25 wall jib cranes. Some of the jib cranes will be equipped with fast electric hoists and others with high speed Triplex hoists.

In this bay are located the following departments, with a brief description of the machinery located therein, as well as a brief description of the major operation on each tool:

WHEEL WORK

90-in. Driving Wheel Lathe.—For turning driving wheel tires.

Combined Journal Turning and Quartering Machine.—To be used for turning crank pins, turning all journals, facing hub liners and quartering wheels.

54-in. Tire Turning Lathe.—To be used for turning tires on trailer wheels, engine truck wheels, and tank truck wheels, and turning narrow gage drivers. Can also be used for coach wheels when required.

32-in. by 18-ft. Engine Lathe.—For driving trailer, engine truck and tank truck axles, shafting, steam hammer pistons, turning old axles for bar stock, etc.

30-in. by 14-ft. Engine Lathe.—For crank pins, heavy knuckle pins, crosshead wrist pins and miscellaneous heavy work.

96-in. Boring Mill.—For boring tires, turning wheel centers, front end rings, large piston heads and bull rings and large gears and pulleys.

600-Ton Wheel Press.—Pressing on and off driving, trailer, engine and tank truck wheels. Pressing out crank pins, etc.

Tire Heating Furnace and Blower.—Heating tires for applying on wheel centers.

Two—1½ in. by 12 in. Double Bench Grinders. General Tool Grinding.

Counter-balancing Stand.—For counter-balancing driving wheels.

DRIVING BOX WORK

48-in. by 48-in. by 19-ft. Planer.—For driving and trailer boxes.

36-in. by 36-in. by 19-ft. Planer.—For new shoes and wedges, old driving and trailing boxes and equalizers.

32-in. Shaper.—For planing old shoes and wedges, engine truck

hub plates, driving box cellars, driving wheel keys, and eccentric keys.

18-in. Slotter.—Driving boxes, rods, frames, etc.

15-in. Slotter.—Small rods, valve motion work, driving box shells, chafe irons, carrying gear work, etc.

18-in. by 8-ft. Engine Lathe.—Brass driving box plugs, extra large equalizer pins, plugs for wheel centers and miscellaneous driving box and truck work.

50-Ton Vertical Power Press.—Driving box brasses.

72-in. Radial Drill.—Driving boxes, wheel centers, bolted engine wheels, tank wheels, crank pins, and miscellaneous work.

GENERAL HEAVY WORK

60-in. by 60-in. by 14-ft. Planer.—Frames, equalizers, and other heavy work.

54-in. Boring Mill.—Driving boxes, boring engine truck tires, tank truck tires and centers and piston heads.

Plain Milling Machine.—Milling keyways in piston rods, milling for valve motion work, machinery and tool work such as gears, jigs, and die work.

60-in. Draw Cut Cylinder Planer.—Planing cylinders and other heavy work.

3½-in. Horizontal Boring Machine.—Keyways in driving axles, rocker boxes, tumbling-shaft boxes, boring trailer brasses, boring air pump cylinders and general tool work.

48-in. by 20-ft. Engine Lathe.—Cylinder bushings and tumbling shafts.

1½-in. by 12-in. Double Bench Grinder.

ROD WORK

28-in. Shaper.—Rod brasses and keys.

32-in. Shaper.—Rod Brasses and keys.

5-in. Drill.—Boring, drilling and reaming rods.

24-in. by 14-in. Engine Lathe.—Knuckle pins and bushings.

100-Ton Vertical Hydraulic Press.—Straightening rods and pressing bushings in and out.

18-in. by 8-ft. Engine Lathe.—Rod studs and bolts, small knuckle pins, etc., turning ends on rod keys, steel oil cups.

24-in. Boring Mill.—Rod bushings.

1½-in. by 12-in. Double Bench Grinder.

VALVE MOTION WORK

48-in. Radial Drill.—Drilling and reaming large holes and general work.

36-in. Boring Mill.—Eccentrics and straps, slip rings, and general valve motion work.

18-in. by 10-ft. Engine Lathe.—Valve motion pins and bushings, link saddles, etc.

24-in. by 14-ft. Engine Lathe.—Valve yokes, valve stems, valve rods, eccentric arm pins, etc.

Vertical Link Grinder.—Grinding links and link blocks, and miscellaneous internal grinding.

12-in. by 36-in. Plain Grinder.—All valve motion pins, link saddles, etc., air pump piston rods and valve stems.

28-in. Shaper.—All valve motion planing.

4-in. Drill.—Valve motion work and part of the rod work.

CROSSHEAD, GUIDE AND PISTON WORK

36-in. by 36-in. by 10-ft. Planer.—Crossheads, etc.

48-in. by 48-in. by 10-ft. Planer.—Crossheads and miscellaneous work.

4-in. Drill.—Crossheads, piston heads and general work.

24-in. by 12-ft. Engine Lathe.—Crosshead pins, washers, nuts, etc., some small piston rods, stoker pistons and general engine work.

84-in. Guide Grinder.—Grinding guides and miscellaneous surface grinding work.

36-in. Boring Mill.—Pistons, and piston packing and boring crossheads.

100-Ton Horizontal Hydraulic Press.—Pressing pistons on and off.

36-in. by 20-ft. Engine Lathe.—Piston rods.

18-in. by 8-ft. Engine Lathe.—Bolt work, facing nuts and washers, and general work.

3¼-in. by 14-in. by 36-in. Turret Lathe.—Piston and valve stem packing and glands.

24-in. by 10-ft. Engine Lathe.—Crosshead pins, etc.

1½-in. by 12-in. Double Bench Grinder.

The west machine bay will be used for handling lighter work and is served by 11 wall bracket jib cranes with high speed chain hoists. The bay has a runway prepared for the future installation of 15-ton traveling cranes. The following departments, with a brief description of machinery, are located in this bay:

AIR BRAKE AND BRASS WORK

18-in. by 8-ft. Engine Lathe.—General air brake work.

24-in. by 10-ft. Engine Lathe.—General air brake work.

Two 20-in. Brass Turret Lathes.—Brass trimmings.

24-in. Boring Mill.—Air pump pistons and packing rings, brake cylinder piston heads, etc.

20-in. Drill.—General air brake work.

1½-in. by 12-in. Double Bench Grinder.

Triple Valve Test Rack.

Test Rack.—Signal valves, governors, engineers' valve, feed valve, air pumps, etc.

BOLT WORK

3-in. Single Head Bolt Cutter.—Pedestal bolts, piston rod nuts and driving brake rods.

Three 18-in. by 8-ft. Engine Lathes.—Turning bolts.

1½-in. Double Head Bolt Cutter.—Threading bolts.

Centering Machine.—Centering bar iron for bolts.

Bar Shear.—Shearing bar iron for bolts.

2½-in. by 20-in. Wet Grinder.—Tool grinding.

GENERAL BAR STOCK WORK

7½-in. by 26-in. Turret Lathe.—Knuckle joint pins, crank pins, crosshead pins and eccentric crank pins.

3½-in. by 18-in. Turret Lathe.—All carrying gear pins, driving brake pins, small knuckle pins, etc.

3½-in. by 20-in. Turret Lathe.—Valve motion pins, etc.

1½-in. by 24-in. Turret Lathe.—Valve stems, boiler trimmings, hand brake work, etc.

3¼-in. by 28-in. Turret Lathe.—Drive brake pins, etc.

ELECTRICAL DEPARTMENT

½-in. by 6-in. Double Bench Grinder.—General grinding.

DRY PIPE AND PIPE GANG

8-in. Pipe Threading Machine.—Threading 2½-in. to 8-in. pipe.

2-in. Pipe Threading Machine.—Threading ¼-in. to 2-in. pipe.

Pipe Bending Machine.—Bending various locomotive pipes to shape.

24-in. Drill.—Miscellaneous drilling.

24-in. by 14-ft. Engine Lathe.—Dry pipe sleeves, throttle valves, etc.

Brazing Furnaces.—Brazing copper pipes, etc.

6-in. by 6-in. Power Hack Saw.

DRIVER BRAKE WORK

100-Ton Vertical Hydraulic Press.—Pressing bushings in and out.

3-in. Drill.—Carrying gear bushings, and general driver brake work.

24-in. by 12-ft. Engine Lathe.—Driver brake and carrying gear bushings, pins, etc.

20-in. Drill.—Drilling pins, etc.

TOOL ROOM

The tool room is located in the center of the light machine bay, with the general foreman's office above a portion of it. This department occupies a space 60-ft. by 88-ft. and contains the following tools:

27-in. by 16-ft. Engine Lathe.—General machinery and tool repair work.

18-in. by 8-ft. Engine Lathe.—Tool room work.

18-in. by 10-ft. Engine Lathe.—Tool room work.

Universal Milling Machine.—Tool room work.

20-in. Drill.—Tool room work.

4-in. Twist Drill Grinder.—Grinding twist drills.

13-in. by 40-in. Universal Grinder.—Tool room work.

24-in. Shaper.—Tool room work.

3-in. by 18-in. Double Grinder.

2½-in. by 20-in. Wet Grinder.

1½-in. Turret Screw Machine.—Punches and general tool room work.

200-lb. Power Hammer and Two Electric Heat Treating Furnaces.—Tool tempering and hardening.

6-in. by 6-in. Power Hack Saw.

TINSMITH SHOP

36-in. Squaring Shear.—Shearing sheet metal up to No. 16. gage

42-in. Bending Roll.—Rolling sheet metal up to No. 16.

8-ft. Cornice Brake.

CAB SHOP

8-in. by 48-in. Grindstone.

36-in. Band Saw.

Single Spindle Shaper.

16-in. Jointer.

18-in. Swing Cut-off Saw.

1½-in. Mortiser.

15-h.p. Group Drive Motor.

Glue Pot Heater.

ERECTING SHOP

Eight 3-in. by 18-in. Double Grinders.—General Grinding.

All machine tools in the shop except wood-working machin-

ery are equipped with individual motor drives and automatic push button control stations. The operator is thus enabled to start and stop motor and tool with the least possible effort, thereby reducing to a minimum the idle time. From a safety standpoint this is also most important. The tools are all of modern construction with all latest improvements. The machines have been placed so as to permit of installing more machines in the future.

The entire shop is equipped with steam, water, air and electricity. The current used is 440-volt, 60-cycle, three-phase, and 110-volt, single phase, as well as 220-volt direct current for crane service and variable speed motors. The entire shop is provided with Oxweld service for acetylene welding, and with electric welding receptacles for electric welding.

Necessary gangways have been allowed for the use of the motor trucks in hauling material throughout the whole length of the shop.

Boiler Shop

The boiler shop is 130 ft. wide by 308 ft. long. It is constructed of steel, concrete and tile, with a concrete floor, and is served by two through tracks. It is heated by the blast system through underground concrete ducts, and has adequate toilet and locker room facilities as well as a separate office for the foreman.

The west bay, designed for heavy boiler and tank work, is 70 ft. wide and 33 ft. high under the roof trusses, and is served by two 25-ton electric traveling cranes. The one over the tank department has a 10-ton auxiliary hoist. Heavy boiler plate tools and furnaces of the most up-to-date design are located in this bay and are served by wall bracket jib cranes in addition to the overhead cranes.

In the east bay, which is 60 ft. wide by 20 ft. under the trusses, are located the flue and ashpan departments. Adjacent to this bay on the west, is the flue rattler, separately housed. The flue department is equipped with an electric flue welder and other modern flue machinery which greatly increases the efficiency of the welding operation. The whole shop is equipped with electric welding receptacles and Oxweld outlets.

Boilers, flues, ashpans, etc., will be carried from the machine and erecting shop to the boiler shop by means of a 50-ton yard crane.

Blacksmith Shop

The blacksmith shop is 88 ft. wide by 190 ft. long. It has a steel frame on concrete foundations, with brick walls. The lower chords of the roof trusses are 22 ft. above the floor and, with the large, full length monitor in the roof, the ventilation is well provided for. The shop is served by a through track running under the yard crane runway. This shop has a cinder floor. The building is provided with wall radiators and is equipped with shower baths and adequate locker and toilet facilities for the comfort of the men.

This shop is equipped with a 15-ft. car floor annealing furnace and a case hardening furnace with recording pyrometers for proper heat treating, steam hammers from 800-lb. to 5,500-lb., and with forges, furnaces, and other machinery for repairing all classes of locomotive forgings.

All forges and furnaces, both in the blacksmith and boiler shops, are equipped with individual motor driven blower units, which make independent operation possible. It also does away with expensive underground or overhead air ducts which are difficult to maintain, resulting, at times, in a considerable loss of air through leakage. It will also reduce the current consumption for supplying blast to a minimum. Each blower unit can be designed to suit the particular pressure required. For hand forges, the blast requirements are different from those of frame fires or oil furnaces.

Furthermore, no difficulty will be experienced later when additional equipment is added, while with a system of air ducts, it is generally found that some re-arrangement is necessary. The shop is equipped with electric welding receptacles and Oxweld outlets.

To preserve the timbers used for all steam hammer foundations, creosoted oak timber is used. Sufficient wall jib and post jib cranes, equipped with electric and high-speed chain hoists, are installed for proper and easy handling of material.

Frames, rods, and other material to be repaired will be carried from the machine and erecting shop to the blacksmith shop by a 50-ton yard crane.

Power House

The power house is of brick and steel construction 89 ft. wide and 128 ft. long; with a basement. It has a concrete chimney 12 ft. in diameter inside by 250 ft. high.

The boiler room is 78 ft. by 86 ft. and houses four 400-hp. horizontal water tube boilers equipped with superheaters, and natural draft, chain grates, with room for a 100 per cent increase. This room is built high enough to include the overhead coal storage bunkers of 50 tons' capacity, automatically filled by bucket conveyors from a pit under cars on an adjoining track. The ashes are also automatically conveyed from the ash pits to an overhead ash hopper which is conveniently located over the coal and ash track.

In the boiler room are also located the feed water pumps and heater, and other auxiliaries, including the 1,500-gal. per minute fire pump which supplies a separate system of firelines around the shops.

In the compressor room, which is 46 ft. by 86 ft. and is served by a 10-ton hand traveling crane, are located the two 3,400-cu. ft. steam driven, air compressors with additional space for a future unit. Owing to the sandy condition of the ground around the buildings and surrounding country, the intake to these compressors is protected by the latest improved type of air filter.

Three-phase electric current will be purchased at 13,200 volts, 60 cycles, and will be transformed down to 440 volts at the outdoor transformer station adjacent to the power house. Direct current will be furnished by two 200-kw., 250-volt motor generator sets located in the compressor room. Here is also located a 13-panel switchboard of the most modern type, controlling all electric circuits.

Throughout the power plant, means are provided for measuring, weighing and testing, so that proper records and high efficiency may be maintained.

Store House and Office

The store house and office is a reinforced, concrete structure, two stories in height with basement, 80 ft. wide by 160 ft. long. It will only serve the facilities described, and, will not at present, be used as a system distributing store. The general office of the shop superintendent and storekeeper is located on the second floor and the shop surgeon will have his office on the first floor. Electric elevator service is provided for.

The store house will be equipped with steel skeleton material racks and a shop delivery system will be put in effect by which the store department will deliver material direct to the point where it is to be used. Motor trucks and trailers will be used in this service.

Between the store house and machine and erecting shop is the casting platform and loading track served by a 10-ton electric traveling crane equipped with a magnet. To the south of the store house is an elevated concrete receiving platform, 100 ft. by 104 ft. Material will be delivered to the basement direct from cars through outside chutes.

Other Facilities

A 25-ft. by 40-ft. oil house is built of re-inforced concrete, providing a fireproof storage and distribution center for all oil for shop use. A 12-ft. platform is provided on three sides with ramps for inter-communication by tractor with the store house and with the shop. A complete Bowser system of oil storage is also installed.

A yard crane runway, 100 ft. wide by 577 ft. long, is traversed by a 50-ton electric traveling crane with two 25-ton trolleys. It serves the machine and erecting shop, the boiler shop, and the blacksmith shop, located on each side of it, and the lye vat at the west end. The lye vat has two compartments 12 ft. wide and 25 ft. long, one compartment 4 ft. deep, and the other 8 ft. deep, with a drip platform 25 ft. by 25 ft.

The water supply is furnished by two deep wells with two cisterns for supplying drinking water and service water. Additional storage and pressure will be obtained from a 500,000 gallon stand-pipe.

These improvements will cost approximately \$2,500,000, and will give employment to about 750 men. The entire project, both architectural and mechanical, has been designed and supervised by the railroad company.

Report of the Committee on Loading Rules

New Regulations Added for the Pyramidal Loading of Straight Concrete Pipe on Flat Cars

DURING the past year, the committee as a whole, as well as subcommittees, have held meetings with shippers concerning recommendations for changes and additions to the loading rules. A number of suggestions for changes in the rules were also received from the members. Trial loads, embodying new forms of loading, were sent out and carefully followed to destination in order to determine the safety and practicability of such loadings. In its work, your committee has had the hearty co-operation of the steel and automobile industries and is indebted to their representatives for their able assistance.

As a result of these deliberations the committee submits the following recommendations for changes in the rules for your ap-

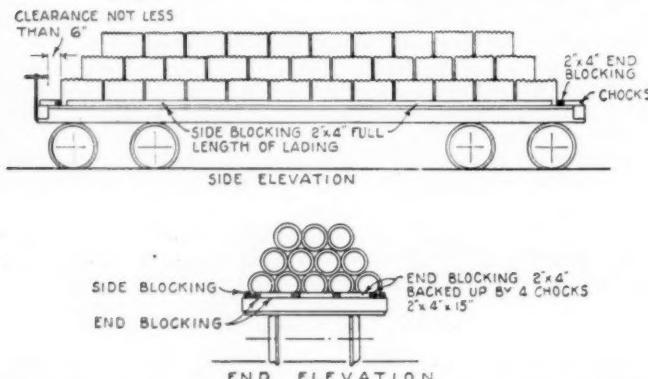


Fig. 110-A—Loading of Straight End Concrete Pipe on Flat Cars

proval and submission to letter ballot for adoption by the Mechanical Division:

RULE 5

To make clear to the shipper what weight of lading may be placed on cars, the following additional note is proposed:

"Where cars are marked with capacity, 80,000 lb. or over, they can be loaded to the above 'Load Weight Limits,' except where other load limit markings are stenciled on the cars."

RULE 9

The wording of the section (a) of this rule has been revised as follows to clarify the meaning; the principle of the rule or permitted load weights has not been changed:

"(a) For loads carried on one bearing-piece per car (with or without sliding-pieces) located at or near center of car, the weight of lading must not exceed two-thirds the capacity of car when carried on flat or drop-end gondola cars of all-steel or steel underframe construction, or on flat or drop-end gondola cars of wooden construction having more than two truss rods. On all-steel or steel underframe flat or drop-end gondola cars constructed with fish-belly girders, the weight of lading must not exceed three-quarters of the capacity of car."

It is recommended to omit reference to Fig. 68 in fourth line of Rule 9 (e) and relocate bearing-piece on middle car of Fig. 67. Fig. 68 does not apply to this rule. The bearing-piece on middle car of Fig. 67 should be relocated on account of weight limits.

RULE 19

This rule is revised as follows to take care of special material, such as bridge girders, columns, etc., that are heavy at one end:

"All carrying cars must be considered of the same capacity as the one of lesser capacity, except where the lading consists of specially constructed material that is heavy at one end. Care should be taken not to exceed weight restrictions covered in Rules 9 (a), 9 (b) and 9 (c) for each carrying car."

RULE 21

This rule is revised as follows to permit securing the lift lever where it cannot be readily disconnected from the coupler lock lift:

"The cars must be jacked apart by placing one jack on each side of the coupler, separating the cars until the couplers are pulled out to the fullest extent, inserting metal blocks (except cast iron) to completely fill the space between horn of coupler and end sill, disconnecting the lock pin connection (where practical) or securing the lift lever so as to render it inoperative. See Figs. 3 and 4.

"Note.—Composite spacing block, as shown on Fig. 3-A, may be used as an alternative arrangement for twin or triple loads."

RULE 27

In the twelfth and thirteenth lines it is proposed to change the reference "Figs. 48 or 53" to read "Figs. 49 and 53." Fig. 48 is obsolete. Fig. 49 is included as an additional reference.

RULE 28

The rule is revised, as shown below, to overcome the difficulty experienced by shippers in obtaining the required 4-in. clearance between lading and floor of car with flexible material. The committee considered this safe on steel or steel underframe cars.

"Bearing-pieces must never be placed between bolster and end of car, unless special provision is made therefor in detail instructions. When there is but one bearing-piece on a car, it must be placed at least 12 in. from center of bolster toward center of car. Sliding-pieces should preferably be placed over the car body-bolster, but in the case of flexible material, in order to obtain the required 4-in. clearance from floor of car, the sliding-pieces may be placed not more than 18 in. ahead of center line of bolster on cars of steel or steel underframe construction."

RULE 155

The second paragraph of this rule is revised to omit reference to 10-in. clearance between lading at the doorway and inside of the door line. In maintaining the 10-in. clearance, material loaded longitudinally with the car works out between the sides of the car and tiers at the doorway. The revised rule permits loading mate-

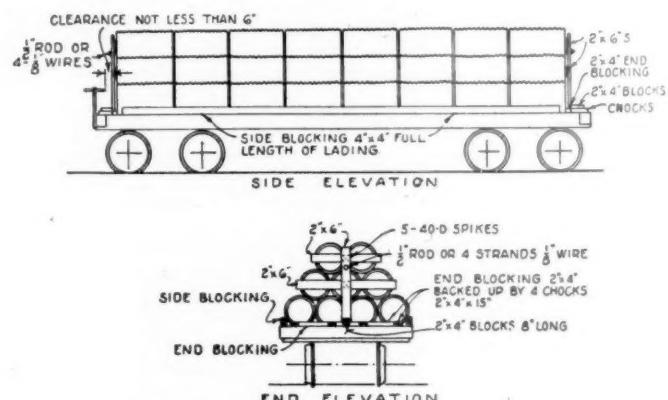


Fig. 110-B—Loading of Straight End Concrete Pipe on Flat Cars

rial at the doorway to the inside line of the car. This will prevent material loaded longitudinally from working out of place.

It is proposed to change Fig. 39 to conform to the proposed change in Rule 155.

RULE 207

This rule is revised to omit reference to form of loading shown on Figs. 47 and 48, which are obsolete, and placed on basis of loading shown in Fig. 49, which is the form in common use. It is proposed to omit Figs. 47 and 48 from the rules.

"Large girders loaded on flat side on flat cars, must always be carried on bearing-pieces not less than 3 in. by 8 in. in section."

Bearing-pieces must be placed near each bolster and not more than 18 in. from center line of bolster. Spacing planks not less than 2 in. by 8 in. in section must be placed between consecutive girders and girders must be clamped together as shown in Fig. 49. Top clamping pieces to be not less than 4 in. by 6 in. in section (hardwood with $\frac{1}{2}$ -in. bolts in each end to prevent splitting) and vertical rods not less than 1 in. in diameter, passing through bearing-piece, floor of car and cleat 2 in. by 4 in. by 18 in. placed longitudinally under floor of car. With loads 24 in. in height or over, braces must be added as shown in Fig. 53.

It is proposed to omit the last three lines of the note at bottom of Fig. 49, reading as follows: "When bearing-pieces must be bolted through floor and cleat as shown in Fig. 37." The bearing-pieces referred to are secured by rods passing through bearing-pieces and floor of car, as shown on Fig. 49, and latter portion of note is unnecessary.

RULE 208

The first paragraph of this rule is revised to permit loading girders and half-roof trusses (single loads) without bearing-pieces where they can be so loaded without damage to the material.

"Open girders, half-roof trusses, and similar material, loaded on single gondola cars, as shown in Fig. 50, must rest on two bearing-pieces when bearing-pieces are necessary to protect car and lading. When loaded on single gondola car with overhang protected by an idler, as shown in Fig. 50-A, two bearing-pieces not less than 6 in. wide and 4 in. thick must be used. On all loads, whether supported by bearing-pieces or not, two timbers not less than 4 in. by 6 in. must be placed above lower chord of trusses or girders, and securely bolted through bearing-pieces, floor and longitudinal cleat under floor. Load must be secured from shifting transversely by pairs of 4-in. by 5 in. hardwood stakes or green saplings 5 in. in diameter at center, and opposite stakes fastened together by means of two 1-in. by 6-in. tie boards, one on each side of stake, and secured at each end by three ten-penny wire nails, the boards passing under and touching top chords of trusses or girders. Two blocks about a foot in length and of sufficient height to block outside girders must be securely nailed with not less than six ten-penny wire nails between tie boards against outside girders. Diagonal braces must be fastened to stakes and cross-tie boards."

RULE 223

This rule has been revised as follows to permit increased length of overhang where cars of long wheel base are used.

"This method of loading, as shown by Figs. 58, 59 and 60, may be made use of to load long lattice girders, columns, one-half roof trusses and similar material that would be injured if loaded on more than one car. The total length of material loaded in this manner shall not exceed twice the distance between center of bearing pieces plus 5 ft., where the material is of uniform weight throughout its length. Where the material is of special construction, with light overhang, a length of overhang not to exceed 70 per cent of the distance between center of bearing-pieces will be permitted. In all cases the limits in Rules 13 and 221 for length, width and height of overhang shall not be exceeded. From a point of safety in transit, it is a very undesirable method and should be used only when absolutely necessary. A maximum limit of 80,000 pounds is placed on loads of this character."

RULE 224

It is proposed to omit from the last paragraph reference to Rule 207, making last sentence of paragraph read as follows: "To prevent longitudinal motion, plates or clamps should be applied in the most suitable manner." Rule 207 is no longer applicable.

RULE 225

To conform with the proposed revision of Rule 28, this rule is revised as follows:

"Bearing-pieces must never be placed between bolster and end of car, unless special provision is made therefor in detail instructions. When there is but one bearing-piece per car, either on floor or on top of car sides, it must be placed at least 12 in. from center of car body-bolster toward center of car. Sliding-pieces should preferably be placed over the car body-bolster, but in the case of flexible material, in order to obtain the required 4-in. clearance from floor of car, the sliding-pieces may be placed not more than 18 in. ahead of center line of bolster on cars of steel or steel underframe construction."

RULE 227-B

It is proposed to change the limit for height of load in paragraph (g) from 6 ft. to 7 ft., making the paragraph read, "Loads are

limited to 7 ft. in height. For allowable weight of load see General Rules 9-A, 9-B and 9-C."

The width of twin and triple loads is greatly restricted on drop-end gondola cars that are narrow between end gate stops, and it is necessary to load 7 ft. high to get the load allowance permitted under Rules 5 and 9.

RULE 227-D

In the first line of the third paragraph, it is proposed to change the limit for height of load from 6 ft. to 7 ft., making the paragraph read, "Loads 4 ft. and not over 7 ft. in height, two binders, located between bearing-pieces, each binder to be located 3 ft. from bearing-piece."

The change is proposed to conform with change in Rule 227-B, Paragraph (g).

FIG. 61

It is proposed to show the bearing-piece at right side of cut, on top of car side in place of below the top of car side, to conform with requirements of Rule 229.

SKETCH A—PAGE 117

It is proposed to change the note reading "wrought iron plate" to read "iron or steel plate," to permit use of material available at the mills.

Rules for Loading Rolled Material of Small

Sectional Area, Rails, Etc., on Open Cars

It is proposed to include General Rule 15 with the group of general rules shown for this class of lading. General Rule 15 covers the wiring together of opposite stakes and applies to the side stakes mentioned in the detail rules under this group.

RULE 302

Rule 302: It is proposed to omit the fourth paragraph of this rule. The paragraph does not adequately cover boiler shells loaded on two or more cars and as this is a special shipment it is recommended that reference to same be omitted from the rules.

NEW RULE 400-A

It is proposed to add a new rule on pyramidal loading of straight end concrete pipe on flat cars, as follows:

Rule 400-A. Pipe must not be loaded more than 6 ft. 6 in. high from floor of car.

Pipe 12 in. to 32 in. in diameter to be loaded in pyramidal form as per Figs. 110-A and 110-B.

Corrugated pipe must be stepped back from end, one-half length of one pipe; smooth pipe must be stepped back full length of one pipe when end bulkhead is not used.

When necessary to load out to a flush end, a suitable bulkhead with a crossarm on each course above bottom course, as per Fig. 110-B, must be placed on each end, tied with a rod not less than $\frac{1}{2}$ in. in diameter or four strands of $\frac{1}{8}$ in. diameter wire from bulkhead to bulkhead through top course of pipe or along center line of load near top. Bulkhead to consist of one 2 in. by 6 in. upright chocked at floor with one 4 in. by 4 in. by 8 in. block, or two 2-in. by 4-in. properly spiked to floor, and one 2 in. by 6 in. cross arm fastened to upright with five forty-penny nails for each course above bottom course.

For pipe 12 to 18 in. in diameter inclusive, use one 2-in. by 4-in. for side blocking. For pipe over 18 in. and including 36 in. in diameter, use two 2-in. by 4-in. for side blocking. For pipe over 36 in. in diameter use three 2-in. by 6-in. for side blocking. End blocking for pipe 12 in. and over in diameter to be in accordance with Fig. 110-A.

This rule is prepared to cover straight end concrete pipe loaded on flat cars. This product is now being shipped in large quantities.

FIGS. 115 AND 117

It is proposed to change these figures to show 2-in. by 4-in. bracing between the bulkheads at doorway in place of 1-in. by 6-in. bracing now shown, in order to increase the strength of the bracing. The change is in line with present practice.

TABLE OF WOODS UNDER RULE 508

It is proposed to omit "Virginia and Carolina Pine" from Group No. 1. It is proposed to substitute, "Short Leaf or Long Leaf Yellow Pine" for the classification "Southern Yellow Pine" in Group No. 2.

After a number of years' experience, the automobile shippers are of the opinion that long leaf or short leaf yellow pine wheel

blocks are practically equal in efficiency for blocking automobiles. Further, the character of the wood is such that it is often difficult to distinguish between the two grades. "Southern Yellow Pine" is a more general classification and has led to some confusion in its interpretation. "Virginia and Carolina Pine" is a species of short leaf yellow pine and should be omitted from Group 1 to conform with the proposed change in Group 2.

RULE 519

The note under this rule is changed to cover devices that are in use and giving satisfactory service. "Note—Any mechanical device used as a substitute for the wheel blocks, side strips or wheel tie downs specified in the rules will be accepted as an alternative if equally efficient to that specified in the rules. Drawings and specifications of such devices shall be filed with the loading Rules Committee."

RULE 532

This rule is revised to permit use of decking constructed of 2-in. by 4-in. commercial material for cars under 2,000 lb. in weight. This decking when carefully prepared and applied, has given satisfactory service with the lighter cars.

"The truss or horse method is the one recommended. It is adaptable to any size or kind of vehicle. The horse required for vehicles up to 3,000 lb. in weight, consists of two legs to the floor and an arm to the wall of the freight car. For vehicles up to 2,000 lb. in weight, 2-in. by 4-in. commercial lumber may be used for the legs if the horses are prepared and applied in accordance with specifications on file with the Loading Rules Committee. For vehicles over 2,000 lb. in weight and up to 3,000 lb. in weight, 2-in. by 6-in. material shall be used for the legs. Four horses are required for double-decking and two for tilting vehicles, one for each wheel or axle raised. (See Rule 500 which governs.)"

RULE 533

This rule is revised to conform with proposed changes in Rule 532.

"The horse required for vehicles over 3,000 lb. in weight consists of three legs to the floor and an arm to the wall. Where three legs are used, 2-in. by 6-in. material will be sufficient for

legs on cars up to 5,000 lb. in weight. For increased weights increase the size of lumber; for instance, a truck weighing 10,000 lb. would have a central leg not less than 4-in. by 8-in. (See Figs. 131 and 132.) (See Rule 500 which governs.)"

RECOMMENDATIONS FOR NEW CARS

In a recent conference on Loading Rules, the Steel Shippers offered the following recommendations in connection with new cars:

First—All drop end gondola cars to be equipped with end gates that are easily removed and replaced (pin and cotter type hinge). With drop-end gates secured to the car permanently (and lying flat on the floor) the shippers have difficulty in getting the required 4-in. clearance between end gate and lading on twin and triple shipments.

Second—All flat and drop end gondola cars to be equipped with drop down type brake staff

Third—Allow greatest possible distance between end gate stops on drop end gondola cars.

As these suggestions are matters of design, they are submitted to the Car Construction Committee for consideration in connection with designs for new cars.

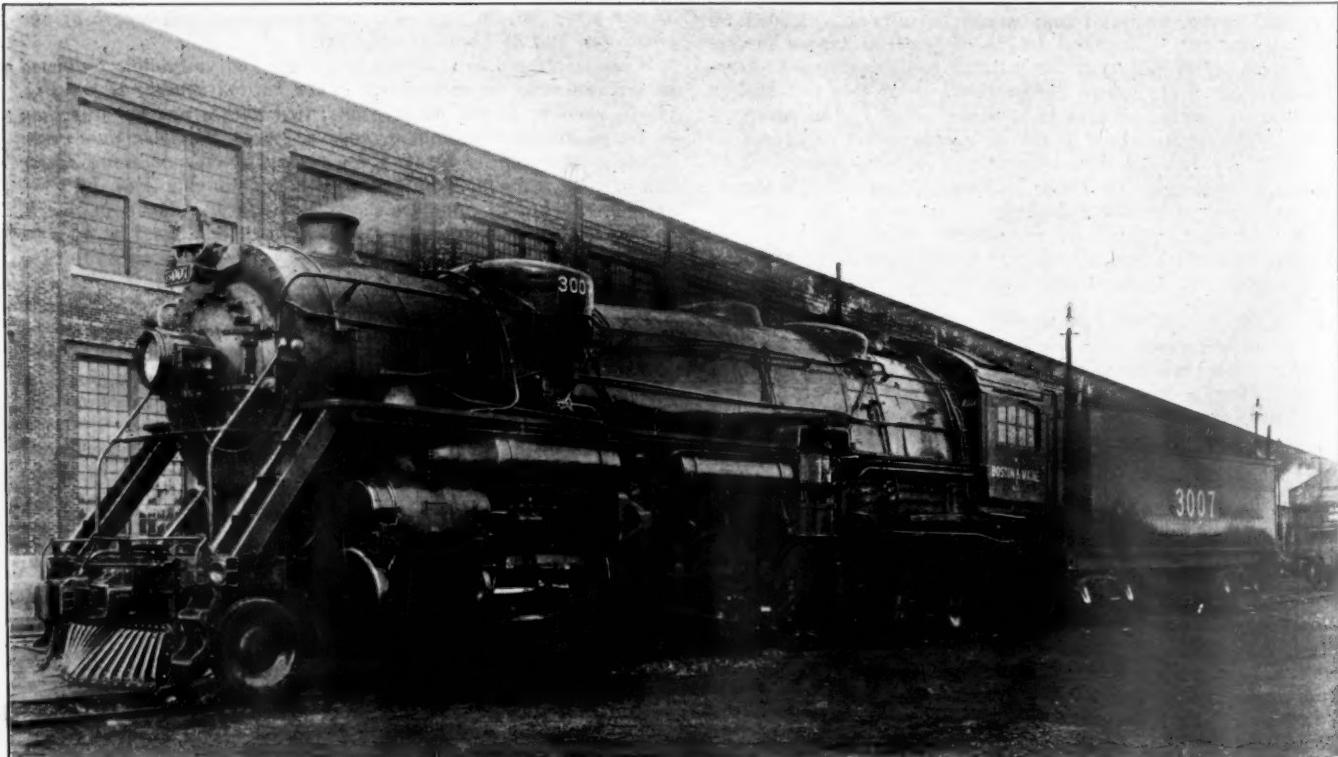
The members of the committee are R. L. Kleine, Chairman, Pennsylvania; R. H. Dyer, N. & W.; E. J. Robertson, M. St. P. & S. S. M.; Samuel Lynn, Master Car Builder, P. & L. E.; Ira Everett, Lehigh Valley Railroad, and G. R. Lovejoy, Detroit Terminal.

Discussion

F. W. Brazier (N. Y. C.): *I move that the report be accepted and submitted to letter ballot.*

Motion seconded and carried.

PORT WASHINGTON, LONG ISLAND, 15 miles out from New York City, on the Long Island Railroad, is celebrating the twenty-fifth anniversary of the opening of railroad communication into the town. The plaza at the railroad station is the scene of some of the principal festivities, including concerts by three bands.



New Boston & Maine Mountain Type Locomotive at Billerica Shops

Report on Prices for Labor and Materials

Prices Changed to Meet Conditions—Reduction in Allowances for Cars Destroyed

THE COMMITTEE submitted the following report under A. R. A. Interchange Rules 101, 107, 111 and 112 of the freight car code and Rules 21 and 22 of the passenger car code:

Prices for Materials—Rule 101

The material prices recommended are the same as those now in force under Rule 101, except for adjustments to meet changed market conditions.

Items No. 1 to 65a, inclusive (covering air brake equipment and pipe fittings) represent latest quotations plus a predetermined percentage to cover store room expense, store room overhead, stock investment and transportation charges.

Items 103 to 214, inclusive (covering miscellaneous car materials), are based on studies conducted during January and February of this year and include transportation charges, store room expenses, etc., as heretofore.

However, the committee feels that, due to the unsettled market conditions, before the issuance of the 1923 A. R. A. Interchange Rules these prices will be investigated and if sufficient increase or decrease develops necessary collections will be made.

Prices for Labor—Rules 107 and 111

The labor rates recommended under Items 172, 442 and 433, Rule 107, are based on the weighted average hourly rate paid repairmen on a number of large representative roads, plus an overhead expense of 62 per cent.

The following are recommended in Rule 107:

Second paragraph changed to read: The labor charges of .95 per hour (Item 172, Rule 101, and Item 442, Rule 107, and \$1.15 per hour, Item 443, Rule 107), in addition to including the actual labor cost of performing the work, include the following items of indirect expense:

Item 58 changed to read: Brake Hanger, R & R or R. (Also to be charged if renewed or repaired when brake beam is R & R or R at same time.)

Item 93: Show 3 hr. opposite this item for both columns, leaving both columns blank opposite Item 92.

Item 136: Change the words "or opposite end" to read "on opposite end."

Item 149 changed to read: Door cap (wooden or metal) R & R or R, includes filler, blocks or castings. Ordinary cars—2 hr.

Item 204-a changed to read: Flooring boards (nailed and bolted or nailed and riveted, or riveted or bolted only) including slope or coke decking on gondola and hopper cars, per sq. ft.

Item 212 changed to read: Hand Rail Rod, side or end, R & R or R per section. Ordinary cars 0.8 hr.

Item 213 changed to read: Hand Rail Pipe, side or end, R & R or R, charge on pipe connection basis.

Item 214 changed to read: Hand rail post, R & R or R, charge on bolt, nut or rivet basis. Excludes R & R or R of hand rail or pipes.

Item 234 changed to read: Lining, under sills or over flooring, per sq. ft. Note: This charge also to be made when sills are renewed or spliced.

Item 248a changed to read: Post, side or end, excluding R & R or R of sheathing, lining and fixtures, renewed, each. Ordinary car, 1.7 hr.; refrigerator cars, 4.2 hr.

Item 249 changed to read: Post, corner, excluding R & R or R of sheathing, lining and fixtures, renewed, each. Ordinary cars, 2 hr.; refrigerator cars, 5 hr.

Item 250 changed to read: Post, corner, renewed, when associated with renewal of side sill, inside end sill, side or end plate, each. Ordinary cars, 1.5 hr.; refrigerator cars, 2.5 hr.

Item 250b changed to read: Post, side or end, renewed, when associated with removal of side sill, inside end sill, side or end plate, each. Ordinary cars, 1 hr.; refrigerator cars, 2 hr.

Item 254 changed to read: Release lever, coupler, R & R or R, includes any or all connections to coupler lock (whether or not in connection with R & R or R of coupler) excludes brackets or castings, each. Ordinary cars, 0.2 hr.; refrigerator cars, 0.2 hr.

Item 257 changed to read: Release lever bracket, coupler, R & R or R, charge on bolt, nut, lag or rivet basis.

Item 278b changed to read: Running board, tank car, end or side, R & R or R, charge on bolt basis.

Item 417a changed as follows: Underframe, steel (all kinds) or continuous metal center sills to which are secured metal body bolsters or metal or wood cross ties, first application or R & R, includes R & R of underframe or continuous metal center sills for renewal or repairs to top gusset plates over cross ties, center girders, bolster stiffeners, or other parts of underframe (excludes R & R or R of flooring, rivets removed and renewed in connection with R & R of underframe and rivets used in repairs to underframe). (Add jacking of car when necessary.)

NOTE: This item not to be charged in connection with sill renewals.

Item 439: First rivet on car any size, applied, net—present, \$0.55; proposed, \$0.48.

Item 440: All other rivets on car after first rivet, applied, net, each:

1/4-in. diameter .....	.08	.07
3/8-in. or 1/2-in. diameter .....	.14	.12
5/8-in. or over diameter .....	.29	.25

Item 442: Change rate from \$1.10 to \$0.95.

Item 443: Change rate from \$1.35 to \$1.15.

Rule 111—Item 19 changed to read: Dirt collector, R & R or R, per connection.

Destroyed or Damaged Cars—Rule 112

The changes under this rule are based on cars built during 1922 on data furnished by the Presidents' Conference Committee for freight train cars. The reproduction cost on such cars that were not included in the report (evidently due to the fact that no class D, E, and F cars were built during 1922) were determined by maintaining the same percentage of differential in the proposed prices as existing in the present rules.

Passenger Car Interchange—Rules 21 and 22

Rule 21—The labor rate under Items 19 and 20 was determined in the same manner as under Freight Car Rule 107.

New Item: 5-a—Belt, charge 0.5 hr. generator on electric lighted equipment, R & R or R each.

[The committee proposes a change in the charges for labor on lubrication from \$0.85 to \$0.75 per hour and on repairs from \$1.20 to \$1.05 per hour.]

Rule 22—Several changes in the prices for materials are proposed for a number of items.

The report is signed by A. E. Calkins (chairman), N. Y. C.; Ira Everett, Lehigh Valley; J. H. Milton, C. R. I. & P.; J. K. Watson, A. T. & S. F.; T. J. Boring, Penn. System; E. H. Weigman, L. & N.; M. Ring, Can. Nat.; H. G. Griffin, Morris & Co., and A. E. Smith, Union Tank Car Company.

Discussion

In the absence of Mr. Calkins, the above report was read by T. J. Boring (Penn. System). Your committee wishes to withdraw its recommendation for changes under Rule 112 covering settlement prices for cars destroyed. As mentioned in the report, the changes suggested were based on costs of cars built during 1922 on data furnished by the Presidents' Conference Committee for freight train cars.

The owners of private refrigerator cars have objected to the decrease in the price per pound proposed by your committee for refrigerator cars, claiming that reduction is not warranted as exemplified by their costs and that the data from the Presidents' Conference Committee did not include a sufficient number of refrigerator cars. Your committee met with the private car owners in open meeting in the secretary's rooms the 19th inst. and as a

result of the arguments presented it was decided to withdraw the recommendations under Rule 112 in order to consider further the prices for refrigerator cars, at least.

Your committee will request the private car owners to submit their costs, which will be considered along with data from Presidents' Conference Committee in establishing the prices that will be included in the next issue of the Interchange Rules. The

prices for all cars will receive due consideration at the same time.

Chairman Coleman: You have heard the report. A resolution or a motion that the report be approved, recommending that the changes be incorporated in the Rules of Interchange, will be in order.

J. J. Tatum (B. & O.): *I will make a motion to that effect. (The motion was duly seconded and carried.)*

Economy From Modern Shop Machinery

Comparison of Modern and 40-Year-Old Machine Tools as Regards Productive Capacity

THE subject of economy from modern shop machinery was brought up near the close of the session and the only discussion was that of Mr. Mullinix, presented in writing.

By S. W. Mullinix

Shop Supt., Chicago, Rock Island and Pacific

This is a very interesting subject and one that inspires the real progressive shop man to get out of the stagnant pool into the current where things are moving. Understand that in the shops referred to locomotives are either built or overhauled. In answering the question, we might view it from different angles. For instance, let us go back forty years to the time when we built a shop to take care of what was then the modern locomotive. We installed in this shop what was then modern, up-to-date machinery, capable of taking care of any work that might accrue. What I wish to do is to draw a comparison showing what was necessary then in relation to requirements at the present time, all brought about by the increased size of the locomotive and need for economical production. The former shop would be equipped with a power plant and equipped with three or four tubular boilers, fire and feed-water pumps and possibly an air compressor, which gave us 400 or 500 ft. of air per minute; that was all.

A High Speed (?) Tool

We then go to the machine shop and install the *monster* 72-in. wheel lathe with the crank pin turning and boring attachment; belt driven; angle irons bolted to face plate extending between spokes of wheels for driving; eight to ten hours required for turning a pair of drivers; speed 10 ft. per min., 1/32-in. feed.

We would next install a planer that would be belt driven; one speed; one head on the cross-rail and no side head; cross-rail raised and lowered by hand; the bedways narrow with abrupt angle, so that oil could get away quickly from where it was needed.

All the lathes, slotters, milling machines, drill presses and bolt-threading machines (sometimes two-spindle but oftener single) would be belt driven. If at night, or on holidays or Sundays, the entire line shaft had to run and probably in addition to this an auxiliary line in order to run one machine to turn a bolt, or take a light cut off a shoe or wedge.

All feed changing on the lathe was done by changing gears. Single geared machines did not cause much lost time, but when compounded, to an inexperienced operator, the necessary changes would be confusing. Bolt threading machines (single-spindle) gave us from four to six hundred bolts a day; two-spindle from 600 to 1000 bolts, lubrication of the dies being by a spoon or dripper. Our boiler shop, as well as the forge shop, had but few machines—a punch and shear in the boiler shop but little machinery outside of steam hammers in the blacksmith shops.

Modern Tools Have Many Advantages

Such machinery as we had in our shop forty years ago would render us very poor service today. Let us compare this old shop of long ago with the modern equipped shop of today, starting out with a power house and such equipment as is necessary to do the work which is expected of it. We install the modern, up-to-date 96-in. wheel lathe; motor drive; controls convenient to the operator, either in front or back of machine; variable speed; pneumatic for loosening tail stock fastenings; and motor to move tail stock to and from the work. With wheel lathes properly designed and

handled we are able to run 13 ft. per min. with 1/2-in. feed which will enable us to get an average of one pair of drivers every 90 minutes, at least. If not, don't blame it on the machine, as you will not find the trouble there, but with the operator, who needs coaching. If he is one of those fellows who tries to make believe he knows it all and will not accept coaching in the proper spirit, change operators.

We next install special locomotive rod milling machines with rod holding fixtures; quick setting of work; all operating levers in front of the operator; micrometer dial indicating depth of cut; feeds and speed as desired; from 100 to 200 per cent more efficient than the old type machine. Next comes the locomotive rod boring machine; two-spindle heavy duty; one operator; doing the work that two men have done; one setting; quick and accurate; easy handling and clamping. Heavy cuts and fast feeds make it at least 200 per cent more efficient than the old-time single-spindle drill press.

The modern vertical rod milling machine requires only one setting of the rod; eliminates drilling and sawing; also slotting. Any desired feed or speed can be obtained and fast traverse of the work table is provided in three directions.

Planers have variable speeds, motor drive, electric control and are capable of taking heavy cuts, governed by the material being machined. Centralized control, rail setting and locking from the operating position, the provision of not less than three heads increases production at least 100 per cent. Guide grinding machines are 200 per cent more efficient than planers and will not only take care of guides, but any other plain surfaces. Turret lathes are today 300 to 400 per cent more economical than the old engine lathe; the work is quickly set up with rapid and accurate production.

Can Old Machines Profitably Be Replaced?

Now I have named a very few machines, there are hundreds of others which will afford a like saving by their use. When we are replacing old machinery in our shop by new, we should be in a position to say whether or not we were losing money by keeping the old machine in commission. I have in mind a 42-in. lathe that has given 18 years' service, and I am quite sure the machine has produced more the past ten months than any twelve-month period before. What has made this possible? The operator is interested and takes great pride in producing. He turns cylinder bushings 22-in. to 30-in. in 2½ hrs., using 7/16-in. feed, running 40 ft. per min. on the roughing cut; ¾-in. feed for the finishing cut. Machines are not built that are going to do any better. The class of work done on this machine does not require unreasonable time in set-ups. It is a motor-driven, heavy-duty machine. A few days ago the operator of a 42-in. vertical mill, placed on this machine a gray iron packing pot to cut up into cylinder rings, 27-in. diameter by 3/8-in. thick, 1-in. deep, getting 30 rings, finishing from floor to floor in 4½ hrs. This was done on practically a new machine, strictly modern. On one of our old tools we could not have made more than 15 rings in the same length of time. I mentioned thread cutting machines, the modern three-spindle thread-cutting machines which have the unit system of lubrication will thread 3000 bolts, ½-in. to 1-in., in eight hours.

I have not mentioned economy in modern, up-to-date pneumatic tools as well as electrical. That is really a revelation and to enumerate the uses and advantages of these tools would take quite a book.

Report on Locomotive and Car Lighting

Trial of New Cab Lamps Suggested—Bushings of Two Inside Diameters Proposed for Axle Pulleys

THE FOLLOWING subjects have been considered by the committee during the year: Locomotive headlight lamps, locomotive cab lamps, axle generator pulley bushings, axle generator belt drive, and car lamps.

Locomotive Headlight Lamps

The committee has kept in touch with lamp improvements that have been developed during the year. The suggestion has been made to the lamp manufacturers that it would be very desirable to obtain a definite mechanical difference in the headlight lamps for the primary purpose of identification. A possible change from the present G type of bulb to the PS type of bulb is reported. This will very likely permit maintaining a separate sized bulb for each size of lamp required and will also permit of improved focusing of the light.

Locomotive Cab Lamps

The 15-watt, 33-volt S-17 lamp now in general use for locomotive cab lighting in gage lamps, etc., has been reported by some member lines as unnecessarily large and a smaller lamp has been called for. A 15-watt, 33-volt S-14 lamp is available and the committee requests that member lines try out the new lamp during the coming year and give the committee a record of the service obtained.

Axle Generator Pulley Bushings

The association has a standard practice that leaves to the user the determination of the actual length of the bushing and its internal diameters, the latter being dependent upon the size of axle and position on the axle at which it is used.

The corrugated steel type of split bushing is today most widely used for this purpose. Due to the lack of established dimensions for these bushings an investigation has developed that a very large number of sizes are in use. For the 5-in. by 9-in. axle alone, over 12 sizes of bushings have been found which are used to a considerable extent. From a study of this subject it has been found that two sizes of bushings for each size of axle will take care of practically all pulley positions in general use today. In this study consideration has been given only to bushings for application to the taper section of the axles. The internal diameters shown for the bushings are based on the assumption that the axles are turned to the actual dimensions given as A. R. A. standard. The lengths for the bushings have been selected to permit using the same bushing either with or without bushing clamp. A long bushing is also desirable, as it provides for a greater range for shifting the bushing along the axle to correct for variations in the actual diameters of the axles along the section where the bushing is applied. Different lengths for the two bushings for the same size axle have been selected to facilitate ready identification due to the small differences in the internal diameters for these two bushings.

The proposed dimensions for axle pulley bushings are given in the table.

TABLE I—AXLE PULLEY BUSHING DIMENSIONS

A. R. A. axle journal in.	Bushing designation	Location of center line of bushing from center line of axle, in.	Bushing dimensions, in.		
			Length	Diameters	
				Inside	Large end
4½ by 8	B-1	13	13	5½	4½
	B-2	7½	12	5½	4½
5 by 9	C-1	13	13	6½	5½
	C-2	7½	12	5½	5½
5½ by 10	D-1	13	13	6½	6½
	D-2	9	12	6½	5½
6 by 11	E-1	12	13	7½	6½
	E-2	9	12	6½	6½

With the type of axle pulley in general use having a hub 6½ in. long and using a bushing without clamps, the range of pulley locations possible for the above bushings when the latter are placed on the axle at locations designated in Table I is shown in Table II.

For axle generator drives where it is desired to have the center line of the belt coincide with the center line of the car it is necessary either to use wide face axle pulleys having two separate hubs or else employing bushings of special design if single hub pulleys are used.

The committee suggests the adopting by letter ballot as recommended practice, the axle pulley bushing and the range of pulley location on the axle as indicated in Tables I and II.

Axle Generator Belt Drive

In view of the importance of the subject of the drive for axle generators your committee has considered it desirable to report on new developments or improvements that are of general interest. During the past year there has been developed the so-called wide face axle pulley, two general designs having thus far been brought out. One design is known as the barrel type of pulley and as first developed was 18½ in. in diameter, 33½ in. over all, having a 1-in. flange. In the later design the length has been decreased to 28½ in. This design of pulley has been used entirely with free speed type of generators with the belt located along the center line of the car. There are at present about 450 of these pulleys in service.

TABLE II—RANGE OF PULLEY LOCATIONS

Bushing designation	Location of center line of pulley from center line of axle, in.	
	Max.	Min.
B-1	16½	9½
B-2	10½	4½
C-1	16½	9½
C-2	10½	4½
D-1	16½	9½
D-2	11½	6½
E-1	15½	8½
E-2	11½	6½

The other design is 18 in. diameter, 24 in. straight face with 2-in. flaring flange. This pulley has so far been used only with the controlled speed type of axle generator, the belt being located approximately 5 in. from the center line of the car. Approximately 100 of these pulleys are in service on one railroad and 50 on another.

These types of pulleys have not yet been in service long enough to permit accumulating sufficient data for a reliable comparison of belt performance with standard pulleys. It has been definitely established, though, that they will prevent belts from running off the pulleys with body hung generators where cars are operated over extremely short radius curves, under which conditions the majority of standard drives for body hung generators will frequently throw off the belts.

There has also been developed and is being tried out in service a universal axle pulley of such construction that it will rotate in a vertical plane so that the pulley remains in line with the belt when the car is running on curves. The pulley was put in service May, 1922, using a 4-in. 5-ply rubber belt with special flexible belt fastener which was reported as still in service on June 1, 1923.

Car Lamps

There is an increased use of the 25-watt 30-34-volt gas filled lamp which the manufacturers are furnishing in the PS-16 type and size and which a member road recommended to be of the PS-18 type and size. It has been suggested that this lamp and the 100-watt, 30-34-volt, PS-25 C lamp be added to the list of recommended sizes for train lighting. The committee believes that in anticipation of a rather radical change in the dimensions and type of bulb used in train lighting it is not advisable to do so at this time.

The members of the committee are W. E. Dunham, chairman, C. & N.; W. H. Flynn, superintendent motive power, M. C.; E. W. Jansen, I. C.; J. L. Minick, Pennsylvania; J. J. Tatum, superintendent car department, B. & O., and E. Wanamaker, C. R. I. & P.

Discussion

W. E. Dunham (C. & N. W.): The committee is looking into the matter of a proper dimensioning of the glass reflectors for headlights. There seems to be a difference of opinion among manufacturers. In giving the figures for his reflector one manufacturer will use the inside depth of the reflector and the inside diameter at the large end; whereas other manufacturers will use the outside dimensions, and this is rather confusing. That particular feature is being checked over and we anticipate having a report on that subject next year.

E. B. Katte (N. Y. C.): May I direct your attention to what appeared to be an omission on the part of the committee, that

might save some money to some of the member companies. While there are some radical changes to be made in car lighting lamps within the next year or so, I do not know of any specific change which will affect the PS-18 lamp. This is a large lamp, gives a little better diffusion and a considerably better appearance, in the existing lamp shade, and it will make a difference in the price, I am told, of some three to four cents a lamp. On one road that might make a saving during the coming year of \$4,000 or \$5,000 in the purchase of lamps. We would appreciate it if your committee, or if this convention might add this lamp as one of the approved lamps at this time.

(A motion that the report be accepted and submitted to letter ballot was then made, seconded and carried.)

Importance of Modern Repair Track Facilities

Present Facilities Generally Inadequate—Able Foremen Needed—Prompt Switching Essential

NOR overmuch attention has been given to repair track facilities in the past. The question is growing in importance as labor becomes more scarce and wages higher. This discussion, therefore, possesses a special value at this time.

By T. H. Goodnow

Supt. of Car Dept., Chicago & Northwestern

It should be recognized that the repair track is an important factor in the operation of a railroad, as maintenance of equipment is one of the most important problems confronting railroad managements. Bad order cars represent capital tied up, with loss of revenue when the cars are out of service.

Modern Repair Track Facilities

In considering a modern repair track and facilities, several things must be borne in mind, the most important of which is the efficient and economical handling of the work. This involves the location of storage, classification and repair tracks, the nature of repairs to be handled, power, machinery, buildings, etc.

Repair tracks are usually located in close proximity to railway terminals from which empty and loaded cars are to be received, and storage tracks should be located and laid out to provide for the classification of bad order cars into different classes. Repair tracks should be located so that the work may be handled to the best advantage and cars repaired and returned to service with the greatest possible dispatch and with a minimum amount of switching.

Car repair work naturally divides itself into two classes; namely, repairs to wood cars, and to steel cars. While the general facilities required for the proper handling of the work are applicable to both, yet each requires facilities peculiar to itself.

The transportation and handling of materials to and from shops, material sheds, platforms and cars is an important item and has a direct bearing on the efficiency of the plant. It is best accomplished by means of auxiliary, or industrial tracks, arranged in such a manner as will expedite this part of the work with the least possible interference with other operations. The relative position of material storage sheds, racks, platforms and oil house should be such as to insure the material necessary for the various operations on cars undergoing repairs being readily obtained and distributed with the least amount of labor and in the shortest possible space of time.

Equipment for Repairing Steel Cars

With the advent of the steel car came the demand for increased facilities on the repair track properly to handle this phase of the work. These demands necessitated the introduction of pneumatic riveting hammers, rivet cutters, drills, heating torches, rivet heaters, welding and cutting torches, jacking frames for straightening and squaring steel cars, etc. In the repair and overhauling of steel cars, there is a large accumulation of sheets, plates, bars, shapes, etc., that have a reclamation value. These plates must

be straightened, repaired and re-used on the car, or placed in stock for subsequent use on other cars. The necessity for the installation of heavy machinery, hoists, cranes, etc., soon became apparent and the facilities on the modern repair track now include such items as power shears and punches, straightening and bending rolls, flangers, blast furnaces, straightening frames and tables, drill presses and emery grinders; also overhead and jib cranes for the transportation and handling of heavy material.

Provision should be made in connection with repairs to steel equipment for the storage of a reasonable quantity of sheets, plates, bars and other metal parts, in close proximity to the machine tool area and in such a way as to enable this material to be unloaded and handled to storage racks and cars by the cranes. Deterioration caused by rust and exposure, should be guarded against.

Where the volume of work to be handled warrants, a gas generator and necessary system of pipes, with outlets at proper distances, should also be installed to facilitate the work of welding and cutting. Such an arrangement not only permits of handling this important feature of the work advantageously but also materially reduces the cost.

A centralized station should be established for the storage, care and distribution of small hand tools, jacks, etc. This will not only insure proper distribution of necessary tools, but will provide opportunity for better inspection, and in a large measure, place the responsibility for proper care and usage upon the individual employee using such equipment. This will also in a large measure reduce the required investment in this class of equipment.

Adequate Lockers Needed; First Aid

For efficient operation of a repair track, provision must be made for the proper housing of the men employed, with adequate and convenient toilet and washroom facilities, a clean, light, sanitary place for them to eat, and good lockers in which to keep their clothing and personal tools. Where the number of men is great enough to warrant, permanent facilities should be arranged to care for injured employees and if permanent facilities are not possible, some arrangement should be made so that early attention may be given to all injuries, serious or minor. This will save suffering and loss of time on the part of the men, as well as loss of services and payment of claims by the railroad.

Able Foremen and Gang Foremen Vital

I have left to the last, the one item that to my mind is the most important; that is, the foremen and gang foremen. These individuals are the ones who are directly handling the expenditure of the millions of dollars annually in repairs to freight equipment. Of the two, give me the active, energetic, interested foremen in preference to modern repair tracks and shops. These men are the ones who are controlling the conservative use of materials in marking up repairs necessary on equipment. They are also the contact between the workmen and the company, and their efforts in interesting the workmen in the output speak either for efficiency, or the contrary. The success of car repair work lies

largely with the supervision, either on the modern repair track or those not so modern.

By T. W. Demarest

G. S. M. P., P. R. R., Northwestern Region

Mr. Goodnow has given us a very able paper in connection with the details of the freight car repair track. Perhaps to some of the operating officers, however, there are other essential features. If you will think back with me the length of your experience and compare how many men worked on a car to get it out when you first went on the railroad and how many days it took as against how many men you are now working on a car and how many days it takes, from my general observation, there has been no material improvement made in speeding up repair work on freight cars. Is it not true, that whenever you were faced with the contingency of additional car work, you went out and bought more property, laid down more tracks and increased your capital investment?

From the management's viewpoint the poor despised freight car takes just as large, if not a larger proportion, of the railroad's income for maintenance as locomotives do. Everybody watches the locomotive and is following the cost of its operation and maintenance, but on the other hand, freight car repair work, which costs at least as much, is either neglected entirely, or its importance is underestimated.

There are some things that Mr. Goodnow might have mentioned, but in the limits of his paper probably could not, and one of the first is this: In the maintenance of freight car equipment you must divide maintenance into two kinds, light or running repairs, and heavy maintenance or rebuilding work. To get economical maintenance on rebuilding work you must segregate it from the light classes of repairs and do it in shops which are equipped for this work.

The next question is: How long are you going to keep the rebuilt cars in the shop? Are you going to keep them in there from four to six days? Are you going to work one or two men on them just as you did 30 years ago, or are you going to develop some working plan that will give you the effectiveness of locomotive repair shops? If we tried to repair locomotives the way

we do freight cars there wouldn't be enough shops in the country to take care of them.

The contract shop uses a method that you have been very slow to adopt, and that is the so-called progressive system, dividing the work into sections, crowding men on each particular kind of work, forcing it through and cutting down the dead time of the cars from six days to two or three days. The method of operation is essentially as important as facilities. The two must go together.

Other Discussion

C. J. Bodemer (L. & N.): There is one feature that it might be well to bring out in connection with this matter which I do not think has been touched upon, and that is the necessity for prompt attention on the part of the transportation department to the switching of bad order cars. You all know that you must have a certain amount of track space to set in a certain number of cars for repair purposes at one time, and as your men go up and down the line of repair tracks finishing one track at a time, it is necessary either to have prompt switching facilities afforded at that time or else a great number of other shop tracks on which dead cars are placed for repairs. Otherwise the men will be out of work while waiting for the next line of cars. I think that prompt switching is a very important matter.

Mr. McCall: Would it not be well to give a great deal more attention to the cleaning and painting of steel freight car equipment? The only way that we will get any relief is by the sand blast system, but there are freight cars in service today that are positively dangerous, simply due to rust. We had a few days ago on our part of the line a fatal accident due to a man actually jumping through the bottom of a steel car that was apparently all right. The man was instantly killed. The bottom of the car was eaten out with rust, and I am afraid that few of the carriers are giving serious enough consideration to protecting the steel equipment from being eaten up by rust.

C. F. Giles (L. & N.): It is important that something be done not only by the individual railroads but by the railroads as a whole to keep this steel equipment in repair. The introduction of steel equipment has not by any means solved the freight problem.

Handling of Material to Car Repair Tracks

Discussion Developed the Need of Adequate Trucking System and Personnel to Handle Material

THIS discussion was the last one scheduled on the program and owing to the lateness of the hour there was time to hear from only two members of the association, R. H. Dyer (N. & W.) and J. C. Fritts (D. L. & W.).

By R. H. Dyer

General Car Inspector, Norfolk & Western

Handling material to car repair tracks is one feature in connection with repairs to cars that in my opinion has never been given the study it deserves. In the laying out of repair yards, convenience in handling of material stands second only to the convenience in getting the cars on and off the tracks. In a great many cases it requires more time for the workman to assemble the material, than it requires for him to perform the work on the car. This condition increases with the track length, as it would be impracticable to scatter material from one end of the tracks to the other.

Proper consideration of the subject at hand should begin as follows:

First: In laying out a repair yard, the tracks should not be over 1,000 ft. long, providing room for twenty cars spaced so that the work necessary on each car can be performed.

Second: On account of the increase in weight of the different parts used in car maintenance, such as couplers, draft gears, etc., it is essential that some means of hauling such material should be provided.

Repair tracks should be spaced with room for a standard gage

service or pushcar track between the 1st and 2nd, 3rd and 4th, 5th and 6th tracks and so on. On these tracks wheels can be moved back and forth and pushcars should be provided for the hauling of heavy material. Where width of space will not permit, a narrow gage track 30 in. wide may be used with small hand trucks to fit. This small truck can be constructed so that a pair of wheels can be easily loaded, transported and unloaded at the proper place. There are also many kinds of small motor trucks on the market that have been found to be economical for hauling materials to repair tracks where tracks are so located that the trucks can be used to advantage.

Third: In order to save time in transporting material to the cars, storage should be located as near the center of repair tracks as possible, with the exception that it has been found advantageous and economical to locate small bins conveniently spaced along shop tracks in which a small supply of bolts, nuts, washers, cotter keys, rivets, etc., may be kept. This saves a great amount of time for the reason that a workman would otherwise walk possibly 500 ft. and return to get a nut or a cotter key, consuming four or five times as much time to secure the article as to apply it.

Fourth: At a small point where a small force of carmen are employed, the foreman in charge is easily able to look after the material and keep up the supplies, but where a force of 25 or more car men are employed, a good experienced car man should be put in charge of material in order that he may keep up supplies, know what he has on hand and be able to tell the workmen where to

find what they want. Such a man in order to properly make out his requisition on the storekeeper should be able to read a blue print.

Fifth: It is also essential that an intelligent car repairer of long experience be placed in charge of delivering material to the workmen. This man should be provided with a sufficient number of laborers to keep the workmen supplied with the proper material.

If the right man is selected for this job, one who knows the dimensions and kind of material needed for certain jobs, he will be able to collect the material and deliver it to the workmen at the car and save more time than any other man around the shops. He would also in the absence of certain material know when a substitute could be used that would often prevent a considerable delay to cars.

By F. J. Fritts
Master Car Builder; D. L. & W.

Local conditions throughout the country vary to such an extent that it is quite difficult to suggest in detail, methods that would fully cover such varied conditions, but there are certain practices or fundamentals that it would seem could be generally followed.

Repair tracks should be supplied with adequate planking, laid on a substantial and solid foundation; the planking to be level with the top of rails, which would not only facilitate handling of material, but repairs as well. Storehouse or supply buildings should be as nearly centrally located as possible, and properly equipped for the storing of material. Saw mills and fabricating steel shops (where installed) should be situated so that right angle turns will be eliminated in handling long materials from the manufacturing shop to cars.

On heavy repair tracks, cars should be taken to stripping tracks and all material that will not be used in making repairs should be removed and disposed of at that point.

Dolly tracks, either standard or narrow gage, should be installed between all tracks. Preference will be governed by spacing of tracks. Standard gage requires greater spacing than the narrow gage. Available space and value of land naturally will govern in such cases.

It has been proven that much time and expense can be saved by keeping the scrap removed from cars separate from new material placed for making repairs. To do this alternate track

spacing should be used exclusively for the removal of scrap material.

Foreman must check the cars and make a list of parts required sufficiently in advance of repairs that material may be delivered in time to avoid waiting or shifting of men to other cars.

The use of electric trucks where proper planking has been installed, can be used to a very good advantage, saving considerable labor and time in delivering material with the exception of wheels and lumber. There has not been an electric truck as yet designed that will handle the items above referred to but it does seem that trailers may be arranged that would meet these requirements. If such an arrangement can be perfected, dolly tracks could be eliminated entirely, but as a general proposition, where required, all things considered, the narrow gage would be preferable because of the extra land required, increased cost of installation and maintenance, and the necessity of operating considerably heavier trucks with practically no increase in material handled where standard gage is installed.

Supplying material on repair tracks should be in charge of a competent labor foreman who will supervise the work, seeing that material is delivered to cars in the order to which repairs will be made, likewise the prompt removal of all scrap material. The installation of these things should very materially reduce the cost of handling material on repair tracks.

Discussion

Secy. Hawthorne: When Mr. Fritts handed me this paper he told me on his way out here he did see an electric truck built especially for the handling of lumber which would be very suitable for that work in railroad shops, and that he had no doubt at all but that one could be designed for the handling of wheels.

THE BALTIMORE & OHIO announces that the Capitol Limited, its new express train between Washington and Chicago, has been taken through on time on every trip since it was put in service, a month ago; a mileage of 47,184 train miles and never a minute late. This train which, westbound, leaves Baltimore at 2 p. m. and Washington at 3 p. m. has a sleeping car which starts from New York at 8:30 a. m. Thus passengers by this route may go through from New York to Chicago by way of Washington in 25 hours, 30 minutes, arrival at Chicago being 9 a. m. Central time.



Bird's Eye View of Eddystone Plant, Baldwin Locomotive Works

Miscellaneous Business of the Meeting

Large Registration—The Division Recommends That the Railroad Centenary Be Observed

THE REGISTRATION at the close of the meeting was 584 railroad men and 87 miscellaneous; a total of 671. A resolution was adopted by the association strongly favoring a Railroad Centenary Celebration of the hundredth anniversary of American railroads.

Safety Appliances

C. E. Chambers (C. R. R. of N. J.):

The committee on Safety Appliances has no written report this year. This is because nothing in particular has transpired since last year. At that time I made a report to you that the investigation on power brake and appliances was under way in Washington; this was carried to completion in February last. At present there is nothing new before the committee other than a possible revision in the Safety Appliance Standards in the near future.

(*A motion was carried that the report be accepted and printed in the proceedings.*)

Loss and Damage From Rough Handling

Chairman Coleman: There is a gentleman here from the Claim Section who wanted to have the privilege of the floor for about five minutes. I want to introduce to you Joe Marshall, special claim prevention officer, A. R. A..

Mr. Marshall: I want to say a few words in the interest of freight claim prevention, but before I say them I want to offer the thanks of the freight claim men for the great co-operation we have received from your secretary, Mr. Hawthorne, in our work and also from the individual mechanical men on all the railroads throughout the country. Each one of them is doing good work.

I want to call your attention to a few of the high spots on the claim account and I have some pictures here to show you.

Mr. Marshall here showed several pictures illustrating various charts used by the Claim Section and indicating the extent of loss and damage from rough handling. The fact was pointed out that in response to inquiry a considerable number of the roads gave six or more miles an hour as a safe impact speed, whereas the best friction draft gear will go solid at four miles an hour, and that evidently there is reason for further educational work along this line. Mr. Marshall suggested that the Mechanical Division appoint a committee on rough handling to back up the work of the freight claim man.—EDITOR.

Co-operating Associations

The privilege of the floor was extended to the following Associations:

Air Brake Association.
American Wood Preservers' Association.
American Railway Tool Foremen's Association.
Association of Railway Electrical Engineers.
Chief Interchange Car Inspectors' & Car Foremen's Ass'n.
International Railway Fuel Association.
International Railway General Foremen's Association.
International Railroad Master Blacksmiths' Association.
Railway Accounting Officers' Association.
Traveling Engineering Association.
And the various sections and divisions of the American Railway Association.

Resolutions

The Committee on Resolutions, C. E. Chambers (C. R. R. of N. J.) made the following report:

"Resolved, that the Mechanical Division of the American Railway Association extend its sympathy to Mr. Samuel M. Vauclain account serious illness of Mrs. Vauclain and a wish for her speedy recovery, and the thanks of the Association for his extremely interesting and instructive paper on the Development of the Steam Locomotive, and that a telegram be sent Mr. Vauclain by the Chairman."

(*The resolution was adopted.*)

Mr. Chambers continued:

"Whereas, Mr. R. H. Aishton, president of the American Rail-

way Association, favored us with his attendance and timely address.

"Whereas, Mr. W. B. Storey, president of Atchison, Topeka & Santa Fe, was in attendance and gave us much food for thought and practice in his address.

"Whereas, Mr. C. H. Markham, president of Illinois Central, personally met with us and favored us with a splendid talk full of appreciation of the workings of the Mechanical Division and the mechanical departments of the railroads as a whole,

"Whereas, Mr. E. F. Carry, president of The Pullman Company, met with us and read his most splendid paper on Development of Railway Cars,

"Whereas, Mr. W. W. Atterbury, vice-president of the Pennsylvania Railroad, favored us with a splendid message of appreciation full of suggestions, and

"Whereas, Sir Henry Thornton, K. B. E., president of Canadian National Railways, showed his keen interest in the railways of the United States and Canada by sending to us his message,

"Be it resolved, that the thanks of the members of the Mechanical Division be extended the gentlemen above mentioned and copy be printed and sent to them individually by the secretary of the Division."

(*The motion was seconded and carried.*)

Mr. Chambers: "Resolved, that the appreciation of the members of the Mechanical Division of the American Railway Association be extended to the Hotel Managers' Association of Chicago for their kindly interest by furnishing accommodations to the members of the association and their families. Also to the Chicago Association of Commerce, and especially Mr. Bowman, for providing a hall in which to hold its annual meeting."

(*The motion was seconded and carried.*)

Mr. Chambers: "Resolved, that the Mechanical Division of the American Railway Association show its appreciation of the continued interest of the executive members of the Association by adopting a schedule of the American Railway Association presented to us by President Aishton, and that each member goes to his own road determined to meet every suggestion and that the note be paid in full on or prior to October 1, 1923."

(*The motion was seconded and carried.*)

Mr. Chambers: "Resolved, that the Mechanical Division extend its thanks and appreciation to the officers and secretary of the division for the able manner in which they have handled the annual meeting and to the committees in charge of the various reports which have been so fully covered and to the members who have participated so generously in the discussions, thereby bringing out the information so much desired, realizing that all of this has taken place at a time when each member, due to the labor disturbances for the past year, has been so fully engaged otherwise."

(*The motion was seconded and carried.*)

Railroad Centenary

The following was also presented by the Committee on Resolutions:

Secretary Hawthorne (Reading): To the executive officers of the American Railway Association. The Mechanical Division of the American Railway Association, assembled in convention at Chicago, on this date, June 22, 1923, taking pride from the beginning of developments and achievements of American railroads of which it is part, noting its problems and looking solicitously to its future welfare, suggests the proximity of the hundredth anniversary of the American Railroads; expresses the belief that this event will afford an invaluable opportunity for the railroads to quicken the pride of railway men in the substantial and effective method of giving an exhibition of progress and recommends the Executive Officers to give serious consideration to the holding of a centennial celebration of international interest, representing the combined energies of all American railroads.

This body stands ready and willing to assist and co-operate in any action taken towards this ending.

Mr. J. J. Tatum (B. & O.): *I move that the resolution be adopted.*

(*The motion was seconded and carried.*)

General News Department

The Telegraphers National Bank, of St. Louis, Mo., which is controlled by the Order of Railroad Telegraphers, was opened for business on June 9. The opening coincided with the thirty-seventh anniversary of the founding of this brotherhood.

The Missouri Pacific will begin about July 1, the publication of a monthly employees' magazine, to be known as the Missouri Pacific Magazine. L. W. Baldwin, president, has announced the appointment of E. H. McReynolds as editor of the publication.

The Interstate Commerce Commission has denied a petition of the Pere Marquette for a modification of the commission's train control order to permit the installation of automatic train control between Alexis, Ohio, and Romulus, Mich. instead of between Grand Rapids and Detroit, Mich.

The American Short Line Railroad Association is to consolidate all of its offices in Chicago on the first of July at 1832 McCormick building. At the present time, the Purchasing Agency is located in the Railway Exchange building and the traffic and labor departments in the Transportation building.

Shopmen on the Denver & Rio Grande Western are threatening a resumption of the strike which was recently called off on condition that the road would consider them for re-employment, with the exception of individuals who were classed as objectionable. The men declare that the road is going into the open market for labor.

The Delaware & Hudson and eight subsidiary corporations have brought suit in equity in the Federal Court at New York City asking an injunction to forbid the Interstate Commerce Commission to fix tentative valuations on their property. Plaintiffs declare that the valuations which have been made by the commission do not include the original cost, to date, of the properties, nor do they truly represent their present value, or the cost of their reproduction.

In the derailment of passenger train No. 3 of the Atlanta, Birmingham & Atlantic, near Hatley, Ga., on June 11, about 1 a. m., 19 passengers were injured, and nearly all of the passengers in one coach were almost drowned. The derailment was due to the failure of a culvert because of heavy rains, and two coaches were ditched and partly submerged. The reports say that the electric lights in the coaches were not extinguished; and that but for this favorable circumstance a number of passengers, who were completely immersed, would probably have been drowned.

The Moffat Tunnel Act, which provides for the financing of a six-mile tunnel through the Continental Divide on the line of the Denver & Salt Lake Railroad by assessment on the property included in an improvement district served by this railway, was held constitutional in a decision of the Supreme Court of the United States last week. In December, 1922, the Colorado Supreme Court handed down a unanimous decision upholding the constitutionality of the act, in a friendly suit which was brought to test the validity of the bonds which are to be issued to finance the work. The case was then carried to the United States Supreme Court.

Grade crossings in Hammond, Ind., are being considered by representatives of the city and the railroads with a view to eliminating as many as possible. Twelve roads, including the Baltimore & Ohio, the Chesapeake & Ohio, the Chicago, Indianapolis & Louisville, the Elgin, Joliet & Eastern, the Erie, the Michigan Central, the New York Central, the

New York, Chicago & St. Louis, the Pennsylvania and the Wabash have lines entering the city. Plans for track elevation have been considered, but also it has been proposed that all tracks except those of the Michigan Central be abolished and all the trains entering the city be operated over that road.

Robert W. Hunt, president of Robert W. Hunt & Co., Chicago, was the recipient of the Washington award which is presented annually by the Western Society of Engineers, acting jointly with the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers. This award was established by John W. Alvord, consulting engineer, of Chicago, in 1916, and was presented to Mr. Hunt for "his pioneer work in the development of the steel industry and for a life devoted to the advancement of the engineering profession." The presentation of the award was made on the occasion of the annual dinner of the society in Chicago on June 17. This is the second time that this award has been made, Herbert C. Hoover being the first recipient.

The Durham & Southern Railroad Company has been fined \$8,000 in the United States District Court at Raleigh, N. C., for violation of the rules of the Interstate Commerce Commission regulating the transportation of coal during the scarcity of last year. The penalty is based on the action of the road in diverting 25 carloads of coal to various tobacco and cotton manufacturers when the coal had been ordered for the use of the railroad company. According to the rules, railroads were placed in class 2 and the industries in class 5, and putting the manufacturers in class 2 was not allowable except by permission of the commission. The railroad company in its defense denied the legality of the embargo on coal. The maximum penalty under the law would have been \$12,500. It is said that the owners of some of the favored industries control the railroad company.

Signal Section Meeting

The Signal Section of the American Railway Association will hold its regular November meeting at the Hotel Pennsylvania, New York, on November 14, 1923. The annual meeting next March will be held at Chicago on Thursday and Friday the 13th and 14th. The hotel at which this meeting will be held has not yet been decided on.

Canadian Shopmen Seek Increases

Notice has been served on the Railway Association of Canada by the Railway Employees' Department of the American Federation of Labor that negotiations looking to wage increases are requested. The shop employees are now working under a contract made a year ago which reduced wages and made the new rates continuous until such a time as either party might desire a change—in which case a conference was to be called on a notice of 30 days. The shopmen have now given that notice.

Cost of Pneumatic Mail-Tube Service

To decide whether any revision should be made in the rate of pay for the transmission of mail by pneumatic tubes in New York City and Brooklyn by the New York Pneumatic Service Company, the Interstate Commerce Commission has announced that it will inquire into the matter. The present contract between the Post Office Department and the company provides for an annual expenditure not in excess of \$513,912, authorized

by the Post Office appropriations bill for the fiscal year ending June 30, 1923.

The annual rate of expenditure per mile of double line of tubes is \$18,500. The law provides that this rate may be revised by the Interstate Commerce Commission upon application before July 1, from either the Postmaster General or the pneumatic tube company but that in no case shall the rate exceed \$19,500 per mile. The proceeding has been assigned for hearing July 10 at Washington before Examiner Frank E. Mullen.

The Norfolk & Western Magazine

Volume 1, Number 1, of the Norfolk & Western Magazine, the June issue, has been distributed. The magazine has 84 pages, 8 in. by 11 in. It is well illustrated and printed on a good quality of coated paper. Many interesting articles about the railroad appear in the first number as well as special features dealing with house building, cookery, fashions, radio, sports, new books and general news. Holcombe Parkes, formerly associate editor of the *Railway Age*, is the editor of the new publication.

A 24-Hour Locomotive Run

Hauling a special train of 10 cars carrying Shriners on their return from Washington, locomotive No. 411 of the Missouri-Kansas-Texas, starting from St. Louis, Mo., on June 10 at 4:25 p. m., was run through to Austin, Tex., 975 miles, without being detached from the train and arrived at destination on schedule time at 5 p. m. This locomotive, an oil burner, consumed on the trip 7,335 gallons of fuel. The rate of speed figures out 39½ miles an hour and the fuel consumption at 7½ gallons per mile.

Automobile Accidents at Highway Crossings

Accidents involving automobiles and automobile trucks at highway crossings have increased since 1917 about 50 per cent, according to a memorandum for the press prepared by the Bureau of Safety of the Interstate Commerce Commission. In that year there were 2,076 such accidents, resulting in the death of 1,083 persons and the injury of 3,000, while in 1921 there were 2,940 accidents, 1,259 persons killed and 3,976 injured. Mail and telegraphic reports made by the railroads to the bureau for the week ended June 2, 1923, show 35 fatal accidents of this character, causing the death of 55 persons.

Adjustment of Brake Power on Tank Cars

Complying with requests received from a majority of the owners and operators of tank cars for an extension of the effective date for complying with the requirements of the tank car specifications for the adjustment of brake power on existing cars, the general committee of the Mechanical Division, American Railway Association, has extended the time limit which had been set at July 1, 1923, to July 1, 1924. The reasons for allowing the extension of time are the general business conditions which have prevailed for some time and the fact that a large number of tank cars, scattered throughout the country, are stored on railroad sidings, making it impracticable for the owners to complete the work of adjustment within the time limit originally set.

To Record Enginemen's Vigilance

An apparatus by which a locomotive runner records on the tape of a speed indicator his approach to a signal which is set against him is described in the *Railway Gazette*, London, of June 1, 1923, page 811. The article seems to indicate that the machine can be used with the Hasler or Teloc speed indicators, but no name of any railroad or any maker is given, and whether the apparatus is in actual use is not stated. The design of the apparatus is to compel the engineman to observe a signal after he comes within 3,000 ft. of it and before it is too late for him to stop; or if he fails to make the record, to expose his negligence. It is claimed that the marks on the tape, which consist of simple triangles composed of small circles, are readily seen, understood and recorded by the clerk who checks the speed records.

Training of Oxy-Acetylene Welders

The American Welding Society has issued an outline of a course for the training of oxy-acetylene welders. This report was prepared by a committee and combines the experience of experts of the Federal Board of Vocational Education, the American Welding Society and the National Research Council. For the information of the person who is selecting candidates, the text includes a discussion of the qualifications which the candidates for training should possess. For the information of the instructor, the text includes the fundamentals in gas welding, together with a detailed statement of content, classified under type welding jobs arranged in the order of difficulty. Copies may be secured from the American Welding Society, 29 West 39th street, New York.

Requests for Wage Increases

The Brotherhood of M. W. Employees and Shop Laborers has asked the United States Railroad Labor Board to have wages increased on the Philadelphia & Reading by the following amounts: bridge and building foremen and assistants, 15 cents an hour; section foremen, 11 cents an hour; mechanics, 14 cents; mechanic helpers, 8½ cents; trackmen, 11½ cents to 15 cents; shop laborers, 11½ cents; bridge tenders and watchmen, 11½.

The Atchison, Topeka & Santa Fe has increased the pay of shopcraft employees 2 cents an hour. This applies to blacksmiths, boiler makers, metal workers, electricians, car men, stationary firemen and oilers.

The Louisville & Nashville has made a general increase of two cents an hour in the pay of all classes of employees in the mechanical department, the increase to go into effect on July 1.

Broad Street Station Re-Opened

The Broad Street Station of the Pennsylvania Railroad, Philadelphia, in which business had to be suspended on Sunday night, June 10, because of the destruction by fire of the train shed, was by Tuesday night, June 19, handling a large proportion of its normal traffic. Large numbers of carpenters and other workmen carried on the restoration of tracks and platforms day and night; and by the 19th all of the 16 tracks in the station were restored to use; but not all of them could be used for passenger trains as the traveler to support the workmen who are taking down the arches of the roof rests on tracks 7 and 10; and from the traveler there is an apron extending to the sides of the shed resting at its outer ends upon tracks 1 and 16. Tracks 8 and 9 are used by the work trains carrying off material. Twelve electric suburban trains were run from the station on Monday, the 11th, temporary platforms having been built at the outer end of the train shed, with stairways leading down to the side street. On Tuesday 155 trains used these temporary facilities, and on Wednesday some of the platforms and tracks were completed to the head house, and the temporary platform was abandoned.

Floods in the Southwest

Heavy damages were caused to railroads in southern Kansas and Oklahoma last week by what were said to be the worst floods in the history of the two states. Most of the roads in the flood territory were tied up from one to seven days, many bridges and miles of tracks being washed away or inundated. Extended interruptions occurred on a number of lines of the Santa Fe, the Rock Island, the Frisco, the Missouri-Kansas-Texas and other roads in that area.

Part of the Frisco bridge over the South Canadian river at Thomas, Okla., was washed away; and the Kansas City, Mexico & Orient bridge, a few miles upstream, was so seriously threatened that traffic over it was abandoned. Six hundred feet of the Santa Fe bridge over the Canadian river at Canadian, Tex., was also washed away, as was the bridge of the Ft. Worth & Denver City over the same stream. The construction of the temporary Santa Fe bridge over the Cimarron river, which is being built to replace one recently destroyed by fire, was interrupted by a five foot rise in the river and part of the bridge material was carried away. Two bridges on the branch of the Santa Fe between Pratt, Kan., and Wichita, one at Calista and another at Kingman, were also destroyed. The Rock Island line from Wichita, Kan., south to the Oklahoma state line, was closed for six days, owing to the loss of the bridge over the Chickasha

river. Some track and a number of small bridges also were washed out between Caldwell, Kan., and Corbin.

G. T. R. Shareholders Referred to English Board

Since the acquisition of the Grand Trunk by the Canadian government, the common and preference shareholders have shown their dissatisfaction at their being "left out in the cold" regarding payments for their holdings. The Canadian government accordingly appointed a committee to report to it on the attitude it should take regarding the claims for compensation. This report, signed by G. A. Bell and Gerard Ruel, vice-presidents of the Canadian National, and G. W. Yates, Deputy Minister of Railways, lays the plight of the unfortunate G. T. R. shareholders at the door of the English board of directors of the company. These directors, the government's committee points out, turned down Canada's original offer for the G. T. R. which would have given fixed dividends to all shareholders except of common stock. The committee called attention to the improper procedure of the London management in dealing with accounts and concluded by expressing the opinion that the "unfortunate shareholders have a strong moral claim against the former Grand Trunk administration."

Report on Collision at Selden, Kansas

The Interstate Commerce Commission has issued a report signed by W. P. Borland, director of the Bureau of Safety, on a collision which occurred on May 18 at Selden, Kans., on the Chicago, Rock Island & Pacific, in which a fireman was killed and two passengers were injured. Westbound passenger train No. 39, moving at moderate speed, ran past the switch at which it should have entered a siding and collided with eastbound passenger No. 6, standing on the main track. The collision occurred at 4:42 a. m. and there was a dense fog at the time. The engineman of No. 39 said that he was unable to see highway crossings and had frequently sounded his whistle as an alarm; but he reached the switch at the meeting point before he was aware of his location and while he was still moving at about 25 miles an hour. He then applied the brakes in emergency, but too late. In train No. 39 there was one wooden car, and this was wrecked but the locomotives and the other cars were not very badly damaged. The eastbound train consisted of 10 steel cars, six of them sleeping cars. The engineman of No. 39 had been in the service of the road since 1874 and an engineman since 1880.

Dispatchers' Association Meeting

The American Train Dispatchers' Association opened its fifth general assembly at the Hotel Sherman, Chicago, on June 18. The meeting lasted for four days and was devoted to the discussion of the wages and working conditions of train dispatchers. J. G. Luhrs, president of the association, in his report, told of the number of disputes brought before the Labor Board and described the manner in which they were settled. Mr. Luhrs expressed the opinion that while much of the criticism of the board was warranted many defects were inevitable in any experiment, and the board had justified its existence. At present, he said, the labor organizations are working on a plan, to be presented to Congress, for the negotiation of wages and working conditions with the railroads. In speaking of the shopmen's strike of July, 1922, Mr. Luhrs said that the railroad managements, aided and abetted by the Labor Board, had begun the formation of company unions. If this movement extended over all Class I roads there would be 4,824 separate railroad labor organizations instead of 35 as at present. Referring to the Dispatchers' Association, Mr. Luhrs charged the railroads with trying to break down the association by intimidation and bribery, through the offering of better wages and working conditions if the dispatchers would get out of the association. Mr. Luhrs favored the establishment of a branch under the Interstate Commerce Commission, similar to the Bureau of Safety, to bring about standardization in train dispatching and establish limits to the territory a dispatcher has to cover; he also said that the chief and assistant chief dispatchers should be limited to a nine-hour day. The report of the treasurer shows total assets of \$210,787.

Traffic News

Announcement is made in Atlantic City, N. J., that regular daily steamship service, for both passengers and freight, is to be established between that city and New York, the landing in New York to be at Pier 12, East River.

A passenger club has been formed at Columbus, Ohio. The purpose of the club, which is composed of employees of passenger departments of all local lines and representatives of foreign lines. The first meeting was held on June 13.

The quartermaster general of the army, under a general order issued by the War Department, has been designated as the traffic manager for the War Department, with jurisdiction over all transportation activities of the army. He is directed to co-operate with the federal traffic board and the chief co-ordinator for general supply of the government.

The order of the Interstate Commerce Commission which granted to the Kansas City, Mexico & Orient increased proportions of rates on traffic interchanged with other roads and which was suspended by an injunction granted to connecting lines by the United States District court at Denver, Colo., will be brought before the United States Supreme Court on October 1.

"Service Progress Special" is the name of a train on the New York Central which is being run over that company's lines in Ohio to cultivate acquaintance and friendship between the railroad and the farmers. The train carries a multitude of exhibits illustrating the history of agriculture and commerce, with information about other matters in which the railways and the public are mutually interested. The train left Cleveland on June 18 with a schedule calling for stops at 27 cities and towns in Ohio.

The New York, New Haven & Hartford reports that on June 12 the total number of freight cars on its lines was 51,159 as compared with 57,881 on April 13 and 62,181 on March 14. The long continued congestion is believed to have been conquered; but officers of the road say that much work is yet to be done to bring the freight car movement to normal condition. In the month of April, the payment for hire of foreign cars amounted to \$641,718, a very much larger sum than for the corresponding period of last year.

Anthracite Shipments in May

Shipments of anthracite for the month of May, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 6,564,285 gross, an increase of 390,511 tons, or 6.3 per cent over April. Comparing the shipments of May this year with the same month in 1921, an increase of 770,390 is recorded, or 13.3 per cent.

The shipment of prepared sizes last month established a record for May, and was only approached during the month of May in the years 1917 and 1918.

Shipments by originating carriers were as follows:

	May, 1923	April, 1923
Philadelphia & Reading.....	1,152,026	1,170,925
Lehigh Valley	1,150,037	1,088,783
Central of N. J.	538,386	508,683
Dela., Lackawanna & W.	985,035	906,203
Delaware & Hudson....	892,471	851,960
Pennsylvania	618,096	527,139
Erie	721,756	647,707
N. Y., Ontario & W.	159,043	146,985
Lehigh & New England.....	347,435	325,389
	6,564,285	6,173,774

Live Stock Rate Hearing Held at Chicago

The Interstate Commerce Commission held a hearing on June 13 to 15 at Chicago covering three combined complaints of western packers against the present rates on live stock and packing house products. At present the rates on live stock are 30% cents a hundred less than the rates for packing house products and the western packers ask for a reduction of the present 30% cent differential to 14½ cents. One complaint, which was filed by John Morrell & Company, Ottumwa, Iowa, against the New York Central, under blanket docket No. 14771, asked for new

rates and reparations for the last three years on fresh and cured meats, packing house products and green salt hides between points in Iowa and points in trunk line and New England territory. It is charged that the rates are built on combinations of the Mississippi river points and are in favor of eastern packers, since they exceed rates on livestock. An attempt was made to shew that a carload of meat can be shipped for less than a carload of live animals. Another complaint, under the same docket number, of Swift & Company against the New York Central, made the same charges and asked for new rates and reparations to the Missouri river packing centers. A third complaint by Wilson & Company, applied to points in Nebraska, Minnesota, Kansas and Chicago. A complaint filed on June 12 by Armour & Company asked for an adjustment of rates so that the difference between the rates on livestock and on packing house products would be approximately 14½ cents instead of 30½ cents.

Examiner Hillyer estimated that two weeks would be necessary for the presentation of the testimony of the complainant packers. The commission had allowed three days for the hearing and it was agreed that at the end of the allotted time the hearing would be resumed at Chicago on September 12, to be followed by a hearing at New York on September 27. S. H. Cowan, who represented the stock growers' association, filed a motion to dismiss the case until the commission investigated and readjusted all livestock and packing house product rates in view of the fact that stock growers were financially unable to defend themselves.

The testimony and cross examination of the first witness introduced by Morrell & Company covered the entire three days.

Cars Moved West for Grain

Rapid and satisfactory progress is reported by the Car Service Division of the American Railway Association in the movement of empty box cars from Eastern roads to their home lines in the West in anticipation of a heavy crop movement this fall. This movement, which began early in the spring and is still in progress, is in ample quantity to fully meet all demands in the Western agricultural sections this fall. The present prospects are that better movement will be given agricultural products this year than ever before in railroad history.

It is stated that there are actually on hand in Texas and Kansas today sufficient grain cars stored and awaiting grain movement to take care of the crops in first-class shape, and that there exists today the best car supply and best movement of commodities that has existed in years on the railroads.

From April 16 to June 8, inclusive, more than 41,000 empty box cars were delivered in Chicago and St. Louis to Western railroads by Eastern lines, while approximately 1,000 empty box cars are now being sent daily to points west of the Mississippi river through those two cities to be held until crops are ready to be moved. In accordance with orders already issued by the Car Service Division, this number was to be increased on June 15 to approximately 1,150 cars daily.

Western railroads have also been directed to hold all box cars now on their lines belonging to Eastern carriers until they can be loaded and returned East.

A check made at principal junction points supplying lines west of the Mississippi River showed that 23,000 more box cars were sent west than were moved eastward from April 1 to June 1, alone. Since June 1, the excess movement of box cars westbound has continued to increase.

Ample cars have already been provided for the movement of the Georgia peach crop, which started about June 1. From that date to June 10, there were 671 cars of peaches shipped while 2,382 additional refrigerator cars are now available for that movement alone.

The railroads are also fully meeting the movement of cantaloupes from the Imperial Valley in California, such movement being fully protected now by all refrigerator cars that can be used.

In order to meet increased freight traffic anticipated this year, the railroads from January 1, 1923, to June 1, put in service 65,660 new freight cars, of which 9,876 were installed from May 15 to June 1. During the first five months of this year 1,697 new locomotives were also installed in service, of which 161 were placed in service during the last half of May. The railroads on June 1 had 107,079 new freight cars on order, most of which are expected to be delivered this year. On the same date they also had 2,041 new locomotives on order.

Commission and Court News

State Commissions

The Railroad Commission of South Carolina, on June 15, following a public hearing, issued an order, to go into effect on August 1, requiring all railroads to discontinue charging a surcharge on passenger fares on Pullman cars within the state.

The Public Service Commission of Georgia has ordered the Gainesville & Northwestern to make, immediately, the repairs to its track necessary to make the road safe. The commission's engineer has made an inspection of the road and reports it in very bad condition, about one-third of the ties being worn out or rotten and useless. This road extends from Gainesville, Ga., northward to Robertstown, 37 miles.

The Supreme Court of Alabama has reaffirmed its decision holding that the Public Service Commission of the state has no authority to order the construction of a new station at Attala, on the Alabama Great Southern, refusing a re-hearing of the case. The commission has authority to require railroads to provide adequate accommodations for passengers but in this case the court held that the needs of passengers could be provided for by the renovation of the existing building.

The Supreme Court of Alabama has decided that the Public Service Commission of the state has no authority to prescribe differential freight rates for industries. The commission had decided to make certain reductions on ore, coal, limestone and other raw materials; but the railroads involved appealed to the court. The Circuit Court sustained the commission but this decision is now reversed. The Supreme Court finds that the law establishing the public service commission limits the power of the commission in this respect to rates open to the general public; railroads may establish preferential rates for certain classes of business, with the approval of the commission, but the commission cannot require the railroads to maintain such preferential rates.

Personnel of Commissions

J. A. Kurtz, chairman of the Missouri Public Service Commission, died suddenly on June 17.

Interstate Commerce Commission

The Atchison, Topeka & Santa Fe has asked the Interstate Commerce Commission to approve and authorize acquisition of control of the Osage County & Santa Fe (Oklahoma) by lease. The Santa Fe owns the entire capital stock of the Oklahoma line except directors' shares. Unified operation will be more economical and permit better service to the public, the applicant represented.

The commission has issued a modification of its order as to freight rates between Mississippi river points in the Memphis-Southwestern investigation and has granted fourth section relief to certain carriers operating west of the Mississippi river allowing them to maintain lower rates from, to, and between St. Louis and crossings south thereof than are contemporaneously maintained on like traffic to and from intermediate points.

Supreme Court of the United States

Moffat Tunnel Benefit District Upheld

The United States Supreme Court in a decision rendered on June 11 upheld the Colorado law creating the Moffat Tunnel Improvement District for the purpose of the construction of the long-proposed tunnel through James Peak on the Continental divide in order to provide a shorter railroad route between Denver and Salt Lake.

North Carolina Income Tax Act

Held Constitutional as to Railroads

The Supreme Court of the United States in an opinion issued on June 4, written by Justice Brandeis holds that the North Carolina Income Tax Act of March 8, 1921, imposing on corporations a tax equal to 3 per cent of the entire net income as therein defined is not unconstitutional because it fails to include among the deductions from income allowed public service corporations (including railroads) the capital charges, including rentals paid other than those specified in the statute. The statute, in terms, taxes only net income. For railroads and other public service corporations required to keep accounts according to the method established by the Interstate Commerce Commission, it makes those accounts the basis for determining the "net operating income" (Section 202 as amended); and it directs that, in order to ascertain the "net income," there shall be deducted from the net operating income (a) uncollectible revenue; (b) taxes for the income year, other than income taxes, and war profits and excess profit taxes; (c) amounts paid for car hire.

The statute was assailed in the federal courts by the Atlantic Coast Line, the Norfolk Southern, the Seaboard Air Line and the Southern on the grounds that it violates the commerce clause, the Fourteenth Amendment and the state Constitution; and only on these grounds. The cases came before the court on appeals by the railroads from decrees of the federal court for the Eastern District of North Carolina dismissing the bills. The decrees are affirmed.—*Atlantic Coast Line v. Daughton*.

The statute referred to divides taxpayers into three classes—individuals, ordinary corporations and public service corporations (including railroads). A contention that this classification is unreasonable was held unsound.

Another contention was that the statute, in fact, taxes gross income. This was also held unsound. The court took the Seaboard Air Line as an example. The results of operation within North Carolina showed net operating income

\$1,148,505.23

less (1) uncollectible revenue, (2) taxes paid,
(3) car hire 710,735.71

Net taxable income earned in North Carolina \$437,769.52 constituting about one-twentieth of the operating revenues of the Seaboard on which sum the state calculated the tax of 3 per cent.

The Seaboard contended it had no net income taxable in North Carolina, but a loss, of which \$254,290.22 was apportionable to North Carolina. This it arrived at by deducting its capital charges (including rents paid) from the sum of its net income (as calculated under the statutes) and its non-operating income. The state treats the operated property as the entity, and does not concern itself with interest charges and the rentals paid. The Seaboard treats the company—the person—as the entity to be taxed, and undertakes to ascertain the net income of the company.

For the Atlantic Coast Line the calculation in accordance with the statute shows a net income of \$1,389,565.25. According to the company's contention the net income was \$333,205.09.

For the Norfolk Southern the calculation in accordance with the statute was said to show a net income of \$653,882.17. (The correct figures, according to the Supreme Court, would seem to be \$603,003.51). According to the company's contention there was a deficit of \$424,338.92.

For the Southern Railway the calculation in accordance with the statute shows a net income of \$2,384,068.71. According to the company's contention the net income on one calculation was \$554,724.41, and on another calculation was \$456,798.56.

To an objection that the statute in ascertaining net income departs from the standard form of accounts prescribed by the Interstate Commerce Commission, the court says that "the Commission's standard form is not immutable. Railway accounting is in process of development."

It appears that the state aimed to confine itself to the property within the state, but the companies, by deducting capital charges, (consisting mainly of interest on funded and unfunded debt and rental charges of leased roads, rolling stock, etc.) either made out a deficit, or greatly reduced the net income taxable.

Foreign Railway News

Sir William Acworth Arrives in Austria

Sir William Acworth, the well-known British Railway economist, has arrived in Vienna to undertake his duties as technical adviser to Dr. Zimmerman, General Commissioner of the League of Nations, according to the Times (London). Sir William will advise on the contemplated reorganization of the Austrian State Railways with a view to making them self-sustaining.

New Line Projected in Mexico

Under a concession which was recently granted by the legislature of the State of Guanajuato a Mexican corporation called the Leon & Manuel Doblado Railroad Company has been organized to construct a railway between Leon and Manuel Doblado, about one hundred miles. It is stated that the project has been financed and that the building of the new line will be started soon. It will traverse a region that already affords a large tonnage of various kinds of agricultural products. This freight movement is now by means of motor truck.

S. P.'s Claim Against Mexican Government

Formal presentation of a claim for 32,000,000 pesos, equivalent to \$16,000,000 United States currency, for damages during the revolutionary period, has been made to the Mexican government by the Southern Pacific Railroad of Mexico, according to information received at Guadalajara. It is stated that a considerable part of this money when paid is to be applied to the construction of the extension of the line which is now being made from a point near Tepic to a connection with the National Railways of Mexico, 25 miles west of Guadalajara. It is understood that the submission of the claim at this time is in accordance with an arrangement made between the Southern Pacific and the administration of President Alvaro Obregon.

China Notes

PEKING.

The seventh annual report on the Chinese Government Railways has just come from the press. It covers operations for the year ending December 31, 1921. Its appearance somewhat late is attributed to the disorganization resulting from the "un-scrambling" of the Peking-Hankow and Peking-Suiyuan lines the year before. The more significant figures, compared with the same item for the preceding year, are as follows:

			Per cent
Item	1921	1920	
Operating revenues	\$96,450,836	\$91,443,932	5 ..
Operating expenses	53,967,045	42,780,106	27 ..
Net operating revenue.....	42,483,791	48,663,826	13 ..
Net income debits (interest, etc.) ..	13,782,725	7,875,738	75 ..
Surplus for the year.....	28,701,066	40,814,448	.. 30
Number of passengers carried	32,909,230	32,123,421	2 ..
Passenger kilometres (millions) ..	3,162	3,161	.. ..
Average number of passenger kilo-metres per km. of line.....	525,812	527,488	.. ..
Average passengers per train	257	283	9 ..
Average journey per passenger (kms.) ..	96	98	2 ..
Number of tons carried	24,996,131	22,154,205	11 ..
Ton kilometres (millions) ..	4,710	4,541	4 ..
Average number of ton kilometres per kilometre of line.....	783,162	757,644	3 ..
Average tons per train	274	294	7 ..
Average haul per ton (kilometres) ..	188	202	7 ..
Average passenger revenue per passenger kilometre	1.10 cts.	1.12 cts.	.. 2
Average freight revenue per ton kilometre	1.18 cts.	1.11 cts.	6 ..
Passenger train kilometres	12,286,954	11,150,583	10 ..
Freight train kilometres	17,170,623	15,433,687	11 ..
Locomotive train kilometres	44,124,098	39,312,894	12 ..
Number of employees	89,043	77,622	15 ..

The report epitomizes the results recorded, using the following language:

"A greater increase in expenses than in revenues, a greater increase in train kilometres, both freight and passenger, than in passenger or ton kilometres hauled, a greater increase in locomo-

tive kilometres than in train kilometres hauled by the locomotives, a greater increase in the number of employees than in locomotive kilometres, train kilometres, ton kilometres or passenger kilometres, or revenues." In other words practically every phase of the service showed a backward tendency.

The large increase in income debits is explained as arising from two causes: (1) the decreasing value of silver which caused interest payments in francs and sterling to cost more in Chinese currency, and (2) the considerable increase in short term loans at high rates of interest due to withdrawals of cash from certain lines by the government. For example the Peking-Hankow shows temporary advances to government of \$8,250,000, which evidently had some bearing upon the fact that it shows as owing under loans and bills of exchange over \$11,500,000. The Tientsin-Pukow, which is in difficulties for funds to meet current requirements shows as advances to government over \$7,000,000. The Ssu-Tao, a new line being built by Japanese capital, shows that out of \$19,000,000 derived from the issue of capital liabilities nearly \$5,000,000 have been advanced to the Chinese government instead of being invested in its own road and equipment. Incidentally, in connection with this line, the map at the beginning of the report shows as under construction a branch headed in the direction of Peking. It was understood in American quarters that the Taonan-Jehol extension had been yielded by the purely Japanese interests to the Consortium group. Why does this Chinese report indicate this extension as continuing to be a portion of the purely Japanese project?

During the past month a commission representing the Chinese government has been examining the accounts of the Chinese Eastern Railway. Under the original agreement between China and Russia regarding this railway, the Chinese president of the line has the right of inspecting the accounts. This right has never been exercised up to the present. The commission consists of J. E. Baker, adviser to the Ministry of Communications, J. B. Bellion, assistant chief accountant of the Peking-Hankow line, Yet C. Owyang, assistant chief accountant of the Peking-Mukden line, and Chu Lin, personal representative of Chang Tso-lin, warlord of the Manchurian provinces. The appointment of this commission was attributed to political moves which the Peking government had in view, and hence it was necessary to keep Chang Tso-lin informed completely as to the actions and findings of the commission. The recent appointment of C. T. Wang, who recently completed the Shantung negotiations, as representative of China to treat with the Soviet representatives, served to confirm political suspicions concerning the accounts commission. But the prime purpose of the commission has been avowed to be that of recasting the annual accounts of the Chinese Eastern in such a way as to make possible comparison of results with those on the Chinese government railways as well as the inclusion of such results in the annual report issued by the Ministry of Communications.

The Worst Accident in History—350 Lives Lost

On June 17 at St. Michel in the Department of Savoie the French Minister of War unveiled a monument in memory of the 350 soldiers who lost their lives on November 12, 1917, in the derailment of a troop train at St. Michel.

The troops, numbering 500, had been fighting with the Italians in the Piave and were returning on leave. As the train was to leave Modane, the first town within French territory, the engineer refused to move saying the train was too heavy to be held by the locomotive or the brakes. The military commandant, however, ordered him to proceed with the result that the train went wild. Applications of the brakes set the cars on fire and the burning train left the rails near St. Michel, crashing into a stone bridge. Less than 150 of the 500 soldiers survived. The French censorship prevented the accident from becoming known.

THE DEMAND for the abolition of all surcharges on fares of passengers riding in parlor and sleeping cars was the subject of a hearing before Commissioner Campbell of the Interstate Commerce Commission at Chicago on Tuesday and Wednesday of this week. The railroads presented testimony concerning the great weight, the small carrying capacity and the heavier terminal costs of Pullman cars. These items are so large that the surcharge is barely sufficient to cover the additional cost of carrying passengers in these cars as compared with carrying them in ordinary coaches.

Equipment and Supplies

Locomotives

THE ARICA-LA PAZ, Chile, has ordered one rack engine from the Baldwin Locomotive Works.

THE DONOVAN CROCKERY COMPANY has ordered 1 Mikado type locomotive from the Baldwin Locomotive Works.

THE GULF, MOBILE & NORTHERN, reported in the *Railway Age* of April 14 as inquiring for 5 locomotives, has ordered 5 Decapod type locomotives from the Baldwin Locomotive Works.

THE UNION RAILROAD, reported in the *Railway Age* of May 26 as inquiring for 15 switching locomotives, has ordered 10 heavy 6-wheel switching locomotives from the Lima Locomotive Works.

Freight Cars

THE DETROIT UNITED RAILWAY is inquiring for 25 flat cars.

THE SINCLAIR REFINING COMPANY, Chicago, is inquiring for 18 coke cars.

THE ANACONDA COPPER MINING COMPANY, New York, is inquiring for 24 Ingoldsby dump cars, 2 ballast cars, and 6 flat cars.

THE NASHVILLE, CHATTANOOGA & ST. LOUIS is inquiring for 75 hopper cars of 55 tons' capacity, and 175 drop bottom gondola cars of 70 tons' capacity.

THE CANADIAN NATIONAL is inquiring for 1,000 automobile cars of 40 tons capacity and for 1,000 box cars of 40 tons capacity, also for alternate bids on 1,000 box cars of 60 tons capacity.

THE MUSCLE SHOALS, BIRMINGHAM & PENSACOLA is inquiring for 50 box cars and 50 flat cars of 40 tons' capacity, also for 50 low side gondola cars and 50 steel hopper cars of 50 tons' capacity.

THE VIRGINIAN RAILWAY has ordered 25, 120-ton gondola cars from the Pressed Steel Car Company, in addition to the 1,000 placed with the same builder as was reported in the *Railway Age* of April 21.

THE NEW YORK CENTRAL is asking for bids for the conversion of 1,000 cars, types not specified, into flat cars, also for the conversion of 500 cars into single deck stock cars and 500 cars into double deck stock cars.

Passenger Cars

THE PACIFIC ELECTRIC, reported in the *Railway Age* of June 2 as inquiring for 50 center entrance street cars, 52-ft. long, has ordered this equipment from the St. Louis Car Company.

Iron and Steel

THE CHICAGO & EASTERN ILLINOIS has ordered 10,000 tons of rail from the Illinois Steel Company.

THE CHICAGO, MILWAUKEE & ST. PAUL is inquiring for 190 tons of structural steel for bridge work.

THE ST. LOUIS-SAN FRANCISCO is inquiring for 325 tons of structural steel for shops at Lindenwood, Mo.

THE BALTIMORE & OHIO has ordered 250 tons of structural steel for bridge work from the Ft. Pitt Bridge Works.

THE WABASH has ordered 235 tons of structural steel for a bridge near Gilmore, Mo., from the American Bridge Company.

THE CHICAGO, MILWAUKEE & ST. PAUL has ordered 188 tons of structural steel for a viaduct at Donovan, Ill., from the American Bridge Company.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has ordered 1,200 tons of structural steel for bridge work from the McClintic Marshall Company.

THE SOUTHERN PACIFIC has ordered 14,000 tons of rail from the Tennessee Coal, Iron & Railroad Company, for delivery during the latter part of 1923 or in 1924.

THE BOSTON & MAINE, reported in the *Railway Age* of June 9 as inquiring for 150 tons of steel for bridges, has ordered this tonnage from the Boston Bridge Works.

Machinery and Tools

THE NORTHERN PACIFIC has ordered a 48-in. car wheel borer.

THE CHICAGO, BURLINGTON & QUINCY has ordered one 200-ton locomotive hoist from the Whiting Corporation.

THE DELAWARE, LACKAWANNA & WESTERN has ordered one 70-ft. 231-ton locomotive transfer table from George B. Nichols & Brother.

THE CHICAGO, ROCK ISLAND & PACIFIC has ordered one 50-ft., 200-ton locomotive transfer table for its Forty-seventh street shops in Chicago, from George B. Nichols & Brother.

THE NEW YORK, CHICAGO & ST. LOUIS will install a 45-ft. 173-ton transfer table at its Stony Island shops, Chicago, which has been ordered from George B. Nichols & Brother.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has ordered one 35-ton crane from the McMyler Interstate Company, one 30-ton crane from the Ohio Locomotive Crane Company and one 30-ton crane from the Orton & Steinbrenner Company.

THE ATCHISON, TOPEKA & SANTA FE has ordered one 63-ft. 215-ton locomotive transfer table from George B. Nichols & Brother. This road has also placed an order for a 36-in. planer, two 2,000-lb. steam hammers, and one 1,100-lb. steam hammer.

THE AMERICAN LOCOMOTIVE COMPANY has placed orders for a 6-ft. radial drill, a double traveling head shaper, a locomotive axle and journal turning lathe, a 100-in. wheel boring and turning mill, a 60-in. planer and a 32-in. shaper; also for a 50-in. boring mill and a 5-ft. radial drill.

Miscellaneous

THE NEW YORK, NEW HAVEN & HARTFORD is asking for bids until 12 o'clock noon July 2 at New Haven, Conn., for its requirements of locomotive and car couplers during the balance of the year 1923.

THE NORFOLK & WESTERN is asking for bids until 12 o'clock noon, July 5, at Roanoke, Va., for its requirements from July 1 to September 30, 1923, of brake shoes; couplers and repair parts; locomotive steel tires; steel spring, and wire fencing.

THE NEW YORK CENTRAL will receive bids until 12 o'clock noon, July 2, for sheets, steel tubes, axles, nails and staples, steel bars, shapes and plates, steel billets, locomotive tires, cast iron wheels, relay protection for 11,000 volt feeders and power station generators and metal parts for bridge and coaling station repairs. Separate bids will also be received on the same date for steel wheels required by the New York Central and Subsidiary lines.

Signaling

THE CANADIAN PACIFIC has ordered 160 relays and 32 switch boxes from the Hall Switch & Signal Company, Garwood, N. J.

BEFORE THE National Coal Association, in convention at Atlantic City, N. J., this week, a report was received from the Committee on Railroad Relations, presenting arguments, worded in vigorous language, in opposition to the plan for pooling freight cars which has been proposed by S. Davies Warfield. The coal men say that the plan would hamper the movement of cars in the bituminous coal fields and that, in general, it should be called nothing more than another step in the program of continual governmental interference in business.

Supply Trade News

THE MERCHANT & EVANS COMPANY, Philadelphia, Pa., has discontinued its Chicago plant and will manufacture all mixed metals at Philadelphia.

THE BOYDEN STEEL CORPORATION has removed its offices from the Keyser building to larger quarters in the Standard Oil building, Franklin street and St. Paul place, Baltimore, Md.

THE HOOSIER WASTE RENOVATING COMPANY, Indianapolis, Ind., has been formed to engage in the reclaiming of oil waste. N. P. Link is president and L. T. Evans and M. W. Evans are vice-presidents.

C. B. SEMPLE, formerly manager of the railroad department of the Steel Sales Company, with headquarters at Chicago, has been appointed western representative of the SIGNAL ACCESSORIES CORPORATION, with headquarters at 450 Railway Exchange building, Chicago.

C. C. ANTHONY, formerly a consulting signal engineer at Auburn, Cal., has been appointed eastern manager of the NATIONAL SAFETY APPLIANCE COMPANY, with headquarters at Chicago. He was born

on September 23, 1863, at Lockport, N. Y., and was educated at Cornell University. He entered railway service in October, 1893, as an electrician maintaining signals on the New York Central and Hudson River, which position he held until June 17, 1895. On the latter date he entered the employ of the Pennsylvania as a signal repairman on the New York division, which position he held until May 1, 1900, when he was promoted to foreman of signals on the Altoona division. From January

1, 1902, until January 1, 1904, he was supervisor of signals on the same division and from the latter date until October 1, 1905, he was supervisor of signals in the office of the signal engineer at Philadelphia, Pa. From October 1, 1905, to August 1, 1907, he was inspector of signals. On the latter date he was promoted to assistant signal engineer, which position he held until August 1, 1917, when he resigned to become a consulting signal engineer.

JAMES C. BENNETT, comptroller of the WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has been elected a director in the place of John R. McCune, who died on May 14. Mr. Bennett is also an officer and director of a number of the Westinghouse subsidiary companies.

F. H. McGUIGAN, JR., regional engineer for the Northwestern, Central Western and Southwestern regions of the United States Railroad Administration, with headquarters at Chicago, has resigned to become assistant to the president of the Railway Car Manufacturers' Association, New York City.

W. O. BRUNING has been appointed chief engineer of the LOUISVILLE FROG & SWITCH COMPANY with headquarters at Louisville, Ky. Mr. Bruning was born thirty years ago and studied mechanical engineering at the University of Kentucky, after which time he taught for a year and then took up engineering specialty work. He has had several years' experience in the design of special track work in the electric and steam railroads. During the world war he served in the aviation service.



C. C. Anthony

The Whiting Corporation, Harvey, Ill., has opened a district sales office at 1526 Jefferson County Bank building, Birmingham, Ala., in charge of **W. R. Hans** as district manager. This office will handle sales in Alabama, Georgia, Tennessee and Northern Mississippi for the Whiting Corporation and its subsidiaries, the Grindle Fuel Equipment Company and the Swenson Evaporator Company. The Whiting Corporation will open on July 1 a district sales office at 624 Penton building, Cleveland, Ohio, in charge of **R. P. Dryer** as district manager. This office will have charge of the sales in Ohio.

E. H. Batchelder, Jr., has opened offices in the Lytton building, Chicago, where he will engage in the handling of railway supplies. Mr. Batchelder was for some years employed by the Chicago & North Western in the operating and executive departments at Chicago, and was later promoted to secretary to the president. During federal control he was secretary to R. H. Aishton, regional director of the North Western region. Following the return of the railroads to the owners, he was appointed secretary to the president of the Union Pacific, with headquarters at Omaha, Neb., which position he resigned to enter the supply business.

Horace S. Clark, assistant manager of the Pacific district of the **Westinghouse Air Brake Company**, has been appointed Pacific district manager with headquarters at San Francisco, Cal., to succeed **C. P. Cass** who has resigned to devote more time to the Westinghouse Pacific Coast Brake Company of which he is president. **E. R. Fitch** has been appointed Southwestern district engineer of the Westinghouse Air Brake Company with headquarters at St. Louis, Mo., and **Lawrence Wilcox**, mechanical expert at Chicago, has been promoted to representative and transferred to the Columbus, Ohio office. **S. T. Reid** succeeds Mr. Wilcox in Chicago.

J. C. C. Holding, who has been appointed assistant to G. W. Struble, in the management of the newly-organized steel car sales department of the **Bethlehem Steel Company**, was for several years with the Midvale Steel & Ordnance Company. After many years' experience in the Structural Department of the Carnegie Steel Company, he resigned in 1917 to become connected with the Midvale Company in the order department. Later he was appointed manager of the railroad division and in 1921 he was appointed manager of the structural division, at the same time having supervision of sales of standard rails, steel freight cars and boiler tubes. Mr. Holding is a graduate of the Rose Polytechnic Institute, Terre Haute, Ind., and immediately after graduation became connected with the civil engineering department of the Johnson Company, now the Lorain works of the National Tube Company. He later spent several years in the structural drafting room of the Shiffler Bridge Works and the Keystone Bridge Works, Pittsburgh, both of which companies were later merged with the American Bridge Company. In 1901 he accepted a position in the office of the structural engineer of the Carnegie Steel Company and shortly after when the general sales department of the Carnegie Steel Company was reorganized and divided into bureaus, he was transferred to the structural bureau. He was with the Carnegie Steel Company for 16 years.

Obituary

William Henry Andrews, chairman of the board of directors of Pratt & Lambert, Inc., Buffalo, N. Y., died at his summer home Watch Hill, R. I., on June 19, after an illness of about a year and a half. Mr. Andrews was born in 1860 at Thomaston, Maine.

Chauncey C. Baldwin, vice-president of the Standard Under-Ground Cable Company, Perth Amboy, N. J., who had been connected with that company for more than twenty years, died at his home in Perth Amboy, on June 7, at the age of 57, after a brief illness.

William E. Manning, vice-president and general sales manager of the Youngstown Sheet & Tube Company, died on June 15 at Youngstown, Ohio. He was born at Youngstown in 1870, and had been with the above company since 1901. Mr. Manning was also president of the Continental Supply Company and the Youngstown Steel Products Company.

Railway Construction

ATCHISON, TOPEKA & SANTA FE.—This company will construct additional yard tracks at Los Angeles, Cal., at a cost of \$195,000, and will enlarge the Harvey eating house at Los Angeles at a cost of \$15,000.

ATCHISON, TOPEKA & SANTA FE.—The Railroad Commission of California has ordered the construction of an underpass at Union avenue, Bakersfield, to be made jointly by the railway company and the city.

BALTIMORE & OHIO.—This company has awarded contracts covering the erection of twenty bridges on its Pittsburgh-Wheeling line. One of these contracts, placed with Vang Construction Company, Cumberland, Md., involves thirteen structures, consisting of "I" beam spans and the smaller types of plate girders and totals about 210 tons of steelwork. The other contract, placed with Pittsburgh Construction Company, Pittsburgh, Pa., involves seven plate girder bridges of a somewhat larger type, totaling about 700 tons. The same road has also placed contract with Fort Pitt Bridge Works for the fabrication and delivery of several plate girder spans and a quantity of repair material to be used at various points on its system; this latter contract involves about 240 tons.

BESSEMER & LAKE ERIE.—This company will receive bids until June 25 for the dredging of a portion of a channel between its docks and for the construction of a concrete dock front at Conneaut Harbor, Ohio. This will involve the excavation of 123,000 cu. yd. of material, the placing of 10,600 cu. yd. of reinforced concrete and 43,000 lin. ft. of 18 in. reinforced concrete piles. This work is to be completed within 10 months.

CANADIAN NATIONAL.—This company closed bids on June 18 for the construction of the water supply facilities at Avonlea, Sask., reported in the *Railway Age* of June 9. This company closed bids on the same date for line revision and the construction of a retaining wall on the Bulkley subdivision, in British Columbia, and line revision for 3½ miles on the Kashabowie subdivision in Ontario. This company has also closed bids for grading for a four-mile spur at Glenavon, Sask.

CANADIAN NATIONAL.—This company has authorized the appropriation of \$2,307,000 for the construction of branch lines from Kamloops, B. C., to Lumby and Kelowna.

CANADIAN PACIFIC.—It is understood that this company plans the extension of the Edmonton, Dunvegan & British Columbia from Spirit River, Alberta, to the Pacific Coast at Portland Canal, B. C., or Alice Arm, a distance of approximately 450 miles. Four surveying parties are now in northern British Columbia to determine the location of the line. The natural resources of the country through which the proposed line would pass are said to be of great value and a number of development companies have already located in the territory.

CHICAGO, BURLINGTON & QUINCY.—This company will close bids on June 25 for the construction of a 250-ton coaling station at Ottumwa, Ia., a 150-ton coaling station at Sesser, Ill., and a 300-ton coaling station at Hannibal, Mo.

CHICAGO, MILWAUKEE & ST. PAUL.—This company is calling for bids for the construction of a foundation for a water treating plant at Bensenville, Ill.

COWLITZ DEVELOPMENT COMPANY.—This company has begun the construction of 10 miles of logging road east of Castle Rock, Cowlitz county, Wash.

DENVER & RIO GRANDE WESTERN.—This company has awarded a contract to Battey & Kipp, Inc., Chicago, for construction of addition to the shops and enginehouses at Denver, Colo., and Salt Lake City, Utah.

FLORIDA EAST COAST.—This company has awarded a contract to M. J. Cole, Jacksonville, Fla., for the construction of the first

section, approximately 20 mi. long, of the extension from Lake Okeechobee, Fla., to Miami, reported in the *Railway Age* of January 27.

GREAT SOUTHERN.—This company plans the construction of a line approximately 80 miles long from Java, Mont., east to Augusta.

ILLINOIS CENTRAL.—This company will close bids on June 27 for the construction of water treating plants at Millington, Tenn., and Brookhaven, Miss.

KANSAS CITY SOUTHERN.—This company plans the construction of a stucco passenger station at De Quincy, La.

LOUISVILLE & NASHVILLE.—This company contemplates the construction of a single track line approximately 30 miles long from McRoberts, Ky., to a connection with the Carolina, Clinchfield & Ohio at Elkhorn City.

MEXICAN GOVERNMENT.—A new railroad, operating under the direction of the Mexican government, has begun construction of a line from Ciudad Silao, Guanajuato, to Manuel Doslado.

MISSOURI PACIFIC.—This company has awarded a contract to H. W. Underhill & Company, Wichita, Kan., for the construction of a 120-ft. by 160-ft. one-story engine house and repair shop at Wichita, Kan.

MOBILE & OHIO.—This company will close bids on July 3 for the construction of a roundhouse and shop buildings at Jackson, Tenn., reported in the *Railway Age* of May 26.

NEW YORK CENTRAL.—This company is calling for bids for the laying of 3,700 ft. of 16-in. cast iron pipe at Gibson, Ind.

NORTHERN PACIFIC.—This company has authorized the immediate construction of a new passenger station at Miles City, Mont., to cost approximately \$50,000.

NORTHERN PACIFIC.—This company closed bids June 21 for the construction of a 28-stall roundhouse at Missoula, Mont.

OREGON SHORT LINE.—This company was given authority by the Interstate Commerce Commission to construct an extension in Ada county, Idaho.

PENNSYLVANIA.—This company has awarded to Henry A. Hitler's Sons Company, Philadelphia, a contract for the removal of its trainshed at Broad Street Station, Philadelphia, recently severely damaged by fire.

ST. LOUIS-SAN FRANCISCO.—This company is calling for bids for the construction of new shop buildings at St. Louis, Mo., to cost approximately \$500,000. The project was reported in the *Railway Age* of March 10.

ST. LOUIS-SAN FRANCISCO.—This company has awarded a contract to T. S. Leake Construction Company, Chicago, for the construction of a roundhouse and shop buildings at St. Louis, Mo., reported in the *Railway Age* of March 10.

ST. LOUIS-SAN FRANCISCO.—This company has awarded a contract to John M. Olson, of Springfield, Mo., for the construction of the terminal facilities at East Thomas, Ala., reported in the *Railway Age* of May 5. This company has also awarded a contract to John M. Olson for the construction of shop buildings at Enid, Okla., also reported in the *Railway Age* of May 5.

TEXAS & PACIFIC.—This company plans the construction of a new roundhouse and engine terminal at Dallas, Texas. Land for the project has already been purchased.

UNION PACIFIC.—This company has awarded a contract to Ziegler-Dalton Construction Company, Junction City, Kan., for the construction of a passenger station at Hays, Kan., reported in the *Railway Age* of May 5.

WESTERN MARYLAND.—This company has awarded a contract to the Price Construction Company, Baltimore, Md., for the erection of a two-story office building and warehouse at Hagerstown, Md. The dimensions of the building are 45 ft. by 200 ft., and it will be of reinforced concrete construction.

Railway Financial News

BOSTON & MAINE.—*Equipment Trust Certificates Authorized.*—The Interstate Commerce Commission has authorized this company to assume obligation and liability in respect of \$2,115,000 of equipment trust certificates to be sold at not less than 97.1.

Suit Against New Haven.—See New York, New Haven & Hartford.

CENTRAL OF GEORGIA.—*Asks Authority to Guarantee Bonds.*—This company has applied to the Interstate Commerce Commission for authority to guarantee \$1,000,000 of 20-year first mortgage 5 per cent gold bonds of the Ocean Steamship Company, of Savannah. The bonds will be sold to the Citizens & Southern Company, of Savannah, at 92.84 to refund at par and interest plus a premium of 2 per cent a like amount of the steamship company's 7 per cent 30-year gold bonds.

CHESAPEAKE & OHIO.—*Equipment Trust Certificates Authorized.*—This company has been authorized to assume obligation and liability for \$371,000 of Elkhorn Piney Coal Mining Company car-trust certificates.

CHICAGO & NORTH WESTERN.—*Equipment Trusts Sold.*—Kuhn, Loeb & Co. have sold \$9,930,000 5 per cent equipment trust certificates, maturing in equal installments from June 1, 1924, to 1938, at prices to net 5.25 per cent.

CHICAGO GREAT WESTERN.—*Authorized to Issue Promissory Notes.*—This company was authorized by the Interstate Commerce Commission to issue, payable to the Pullman Company, not exceeding \$588,047.60 of promissory notes.

CHICAGO, MILWAUKEE & ST. PAUL.—*Abandonment.*—The Interstate Commerce Commission has granted a certificate to this company authorizing the abandonment of a branch line in Clark county, Wis.

CHICAGO, TERRE HAUTE & SOUTHEASTERN.—*Payment of Guaranty.*—Payment of \$83,092 to this company as the balance due on the guaranty totaling \$132,092 has been certified to the Treasury by the Interstate Commerce Commission.

DENVER & RIO GRANDE WESTERN.—*Reorganization Plan.*—Kuhn, Loeb & Co. and the Equitable Trust Company, as reorganization managers, made public a plan on June 20 for the reorganization of the Denver & Rio Grande Western. Bondholders' committees of which John Henry Hammond, James H. Perkins and Richard Sutro are chairmen, and directors of the Missouri Pacific and the Western Pacific have approved the plan.

The plan provides that the refunding bonds of the Denver & Rio Grande, of which \$31,114,000 are outstanding, and the adjustment bonds of that company, of which \$10,000,000 are outstanding, be exchanged for new general mortgage 5 per cent bonds bearing interest from February 1, 1924, and maturing in 1955, and new 6 per cent cumulative preferred stock, at the rate of \$725 of general mortgage bonds and \$400 of preferred stock for each \$1,000 principal amount of refunding bonds with the coupon maturing February 1, 1922, and subsequent coupons, or for each \$1,000 adjustment bond with the coupons of October 1, 1921, and subsequent coupons.

The preferred stock will have no voting power, but without the consent of the holders of two-thirds of that issue there may be no merger, consolidation or sale or lease as an entirety, or any mortgage or guaranty of securities of other railroads or any increase of the preferred stock or any issue of other stock on a parity with or having a preference over the preferred stock.

The plan provides for the creation of a preferred stockholders' committee of three members for the first five years, to be designated by the bondholders' committee approving the plan, subject to approval by the reorganization managers and thereafter to be elected by the holders of preferred stock voting cumulatively. The members of the preferred stockholders' committee are to be entitled to attend meetings of the board of directors of the new company, and one member of the committee is to be entitled to attend meetings of the executive committee and of the board of directors of the Utah Fuel Company. Provision is made for an investigation and report by the committee if four quarterly dividends on the preferred stock are unpaid.

The common stock of the new company is to be vested equally in the Missouri Pacific and the Western Pacific.

Provision is made for financing future improvements, extensions and other capital requirements and for refunding underlying bonds by the creation of a new issue of refunding and improvement bonds prior in lien to the general mortgage bonds, none of which, however, are to be presently issued under the plan. The refunding and improvement mortgage is to authorize the issue of not exceeding \$150,000,000 of bonds, of which there are to be reserved to refund underlying bonds a principal amount equal to 105 per cent of the principal amount of underlying bonds outstanding.

The new company will receive \$10,000,000 in cash, for which no securities other than common stock are to be issued, to be used to make payments contemplated by the plan and for the purposes of the reorganization, including

provision for immediate capital requirements. The new company is to acquire the property now subject to the refunding mortgage and the adjustment mortgage of the Denver & Rio Grande, and also lands, engines, equipment, materials and supplies and securities now owned by the Denver & Rio Grande Western.

The capital stock of the Utah Fuel Company, subject to the pledge of such stock under the first consolidated mortgage of the Rio Grande Western, is to be vested in trustees, subject to a charge for the security of the refunding and improvement bonds and the general mortgage bonds and any bonds or obligations issued to pay or refund those two issues.

Dividends on the stock of the Utah Fuel Company are to be paid to the new company, except that whenever the new company shall have paid all accrued dividends and provided for current dividends on its preferred stock, the Utah Fuel dividends are to be paid to the Missouri Pacific and the Western Pacific, which are to be equal owners of the equity in said stock.

NEW YORK CENTRAL.—Asks Authority to Issue Stock.—This company has applied to the Interstate Commerce Commission for authority to issue \$100,000,000 of capital stock, to be issued, or so much of it as may be necessary, from time to time in exchange for its 20-year 6 per cent convertible gold debenture bonds issued in 1915, of which \$100,000,000 are outstanding. The company's authorized capital stock is \$400,000,000, having been increased to that figure in 1915, of which \$268,377,739 has been issued. The bonds are convertible at 105 and callable at 110.

Annual Report.—This company's annual report for 1922 is reviewed in an article on another page of this issue entitled "New York Central Earnings Justify 7 Per Cent Rate." See also excerpts from annual report on adjacent pages.

NEW YORK, NEW HAVEN & HARTFORD.—B. & M. Stockholder's Petition.—Edmund D. Codman, as owner and trustee of 769 shares of Boston & Maine, has petitioned the Massachusetts Supreme Court seeking to have the New York, New Haven & Hartford enjoined from exercising control over 28 per cent of the capital stock of the Boston & Maine. It was this block of stock which the trustees of the Boston Railroad Holding Company by a decree of the United States Court of the Southern District of New York on June 4 were ordered to return to the New Haven. Mr. Codman asks an order directing the New Haven to transfer all the stock of the Boston Railroad Holding Company owned by it to a board of not less than three trustees appointed by the court for holding and administering the stock with due regard for interests of the New Haven, but in obedience to all the laws of the Commonwealth. The court has issued an order of notice returnable Monday, June 25.

NORFOLK & WESTERN.—Pledge to the Public.—Expenditures Total \$35,578,000.—President N. D. Maher has sent the following letter to the stockholders:

We have pledged our company together with all the other railroads in the country to do whatever is necessary to give adequate service to the public. To accomplish this, we have purchased motive power and equipment as follows: During 1922 we contracted for 7,000 cars, costing \$13,630,000; during 1923 we will contract for 4,000 cars, costing approximately \$10,000,000; a total of \$23,630,000.

In 1922 we contracted for 42 engines, costing \$3,492,000; in 1923 we will receive 4 heavy electric engines, costing \$1,200,000; a total of \$4,692,000.

In 1922 we expended in improving facilities at terminals as well as along the line, in order to expedite the movement of business, \$3,256,000. In 1923 we will expend approximately \$4,000,000, or a total of \$7,256,000. This is a grand total of \$35,578,000. As of June 2 we had freight cars needing repairs, 4 per cent.; locomotives needing repairs, 13 per cent.

"I am giving this brief statement so you may see efforts we are making to provide service for our patrons and I want to ask you to assist me in presenting to the public facts about the railroads, their present condition and financial needs and efforts we are making to provide transportation at reasonable rates promptly and efficiently.

READING.—Asks Authority to Issue Equipment Trusts.—This company has applied to the Interstate Commerce Commission for authority to assume obligation and liability for \$6,000,000 par of 5 per cent equipment trust certificates, to be acquired by the Reading Company, the Philadelphia & Reading Railway or other subsidiaries, and the proceeds applied to the purchase of equipment estimated to cost \$7,004,000 and including 2,000 steel hopper coal cars, 25 locomotives, and about 100 passenger coaches. The certificates will be dated May 1, 1922, and will mature serially at the rate of \$300,000 each 6 months beginning May 1, 1923.

Segregation Plan Filed.—A form of final decree for the segregation of the railway and coal and iron properties in the Reading Company was submitted to the Federal District Court at Philadelphia on June 29 by counsel for the company. Objectors to the plan have the right to apply for appeal to the United States Supreme Court within ten days after the signing of the draft.

SOUTHERN RAILWAY.—Asks Authority to Assume Liability for Bonds.—This company asked authority from the Interstate Commerce Commission Wednesday to assume obligation and liability for \$1,300,000 of City of Greensboro, North Carolina, passenger terminal 30-year 5 per cent gold bonds. The proceeds of the

securities will be used to construct a passenger station at Greensboro. As rental the railroad will pay the interest on the bonds and such other sums as will provide a sinking fund to pay off the bonds at maturity. Arrangements for the sale of the bonds have not yet been made but the applicant has received assurances that they will be disposed of for considerably more than par.

WESTERN MARYLAND.—Asks Authority for Equipment Trust.—This company has applied to the Interstate Commerce Commission for authority to assume obligation and liability in respect of \$1,500,000 of equipment trust certificates to be issued by the Bank of North America and Trust Company and to be sold to J. S. Wilson, Jr., & Co., of Baltimore, in connection with the rebuilding of 2,000 steel hopper cars.

Pennsylvania Settles with Railroad Administration

The director general of railroads on June 15 announced that he had effected a final settlement with the 24 companies comprising the Pennsylvania system for the 26 months constituting the period of federal control. After an adjustment of all accounts between the Railroad Administration and these railroads there is a balance due the government from them, largely on account of capital expenditures, of \$90,000,000. Under the law, this amount will be funded by the government, the railroads giving properly secured paper for the ultimate payment.

This completes the largest adjustment which has been or will be before the Railroad Administration. The tonnage carried by the Pennsylvania system represents about one-tenth of the total traffic handled by the Class I roads, and the equipment, freight cars, locomotives and passenger cars represent about the same proportion of the equipment of Class I roads.

Of the 241,194 miles of road taken over by the government, roads operating 205,496 miles, or 85.2 per cent, have now effected final settlement with the government. The net aggregate of the claims settled is \$692,142,456 and the net amount paid in settlement is \$82,393,642, or 11 per cent. However, the relation between the claims and the net amount paid in this statement does not represent the proportion in which the total claims of the railroads have been reduced in settlement because the \$692,000,000 merely represents the balance after many payments had previously been made on account.

For example, the Pennsylvania had previously paid for part of the capital expenditures. It had a balance due at the end of federal control on account of its guaranteed compensation and also large claims for under-maintenance, which with other items were offset against the capital expenditures.

Treasury Payments

Payment of \$33,120 to the Fordyce & Princeton railroad, Arkansas, as reimbursement for deficits incurred during the period of Federal control was certified to the Treasury by the Interstate Commerce Commission.

Dividends Declared

Allegheny & Western.—\$3.00, semi-annually, payable July 2 to holders of record June 20.

Canada Southern.—1½ per cent, semi-annually, payable August 1 to holders of record June 29.

Cincinnati Northern.—3 per cent, payable August 1 to holders of record June 29.

Detroit River Tunnel.—3 per cent, semi-annually, payable July 16 to holders of record July 7.

Great Northern.—Preferred, \$2.50, semi-annually, payable August 1 to holders of record June 29.

Kansas City Southern.—Preferred, \$1.00, quarterly, payable July 16 to holders of record June 30.

Mobile & Ohio.—3½ per cent, payable July 12 to stock of record June 28.

Northern Central.—4 per cent, semi-annually, payable July 16 to holders of record June 30.

Philadelphia & Western.—Preferred, 1¾ per cent, quarterly, payable July 14 to holders of record June 30.

Pittsburgh & Lake Erie.—\$2.50, payable August 1 to holders of record July 14.

Valley Railroad.—2½ per cent, semi-annually, payable July 2 to holders of record June 21.

Trend of Railway Stock and Bond Prices

	June 19	Last Week	Last Year
Average price of 20 representative railway stocks	63.73	65.63	64.42
Average price of 20 representative railway bonds	83.25	83.93	85.47

Annual Report

New York Central Railroad Company—Annual Report

To the Stockholders of

THE NEW YORK CENTRAL RAILROAD COMPANY:

The Board of Directors herewith submits its report for the year ended December 31, 1922, with statements showing the income account and the financial condition of the company.

Road operated

The following is a comparative table of the mileage operated:

	1922 Miles	1921 Miles	Increase Miles
Main line and branches owned.....	3,716.11	3,699.19	16.92
Leased lines	2,624.62	1,946.64	677.98
Lines operated under trackage rights..	559.24	452.37	106.87
Total road operated.....	6,899.97	6,098.20	801.77

The increase of 16.92 miles shown in main line and branches owned is attributable to a change in classification of track.

The increase of 677.98 miles in leased lines is due to the lease of the Ohio Central Lines (Toledo and Ohio Central Railway, Zanesville and Western Railway, Kanawha & Michigan Railway and Kanawha and West Virginia Railroad), 691.80 miles, which increase is partially offset by a decrease of 13.82 miles due to a change in classification of track.

The increase of 106.87 miles in trackage rights consists of 104.16 miles acquired under the leases of the Ohio Central Lines and 4.38 miles over the Pittsburgh and Lake Erie Railroad, less a decrease of 1.67 miles on the Cherry Tree and Dixonville Railroad.

General conditions

A general revival of business in the early part of the year continued in some industries throughout the year, but the coal strike and later the shopmen's strike caused a serious setback in the return of normal conditions affecting the railroads. Notwithstanding these unfavorable factors, an increased freight tonnage was handled by the company as compared with 1921.

SUMMARY OF FINANCIAL OPERATIONS AFFECTING INCOME

THE FINAL RESULTS OF OPERATION OF THE BOSTON AND ALBANY RAILROAD FOR 1921 AND 1922 AND OF THE OHIO CENTRAL LINES FOR 1922 ARE INCLUDED IN THIS SUMMARY UNDER SEPARATELY OPERATED PROPERTIES—PROFIT, OR SEPARATELY OPERATED PROPERTIES—LOSS, AS THE CASE MAY BE. SEPARATE STATISTICS FOR THESE PROPERTIES ARE APPENDED TO THIS REPORT

	Year ended Dec. 31, 1922	Year ended Dec. 31, 1921	Increase or Decrease miles operated
	5,710.08	5,704.27	5.81 miles

OPERATING INCOME			
Railway operations			
Railway operating revenues.....	\$316,620,098.02	\$292,130,995.06	\$24,489,102.96
Railway operating expenses.....	250,400,469.63	221,768,389.78	28,632,079.85

NET REVENUE FROM RAILWAY OPERATIONS	\$66,219,628.39	\$70,362,605.28	-\$4,142,976.89
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Percentage of expenses to revenues	(79.09)	(75.91)	(3.18)
Railway tax accruals.....	\$17,361,159.94	\$18,132,163.17	-\$771,003.23
Uncollectible railway revenues	53,416.69	54,084.95	-\$68.26

RAILWAY OPERATING INCOME	\$48,805,051.76	\$52,176,357.16	-\$3,371,305.40
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Equipment rents, net debit..	\$1,233,223.46	\$961,046.68	\$272,176.78
Joint facility rents, net credit	2,999,715.64	3,722,724.31	-\$723,008.67

NET RAILWAY OPERATING INCOME	\$50,571,543.94	\$54,938,034.79	-\$4,366,490.85
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MISCELLANEOUS OPERATIONS			
Revenues	\$928,419.03	\$80,682.51	\$847,736.52
Expenses and taxes.....	600,148.50	43,162.21	556,986.29

MISCELLANEOUS OPERATING INCOME	\$328,270.53	\$37,520.30	\$290,750.23
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TOTAL OPERATING INCOME	\$50,899,814.47	\$54,975,555.09	-\$4,075,740.62
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NON-OPERATING INCOME			
Additional compensation and adjustment of standard return under contract with Director General of Railroads for use of the company's railroad property during federal control		\$4,281,607.57	-\$4,281,607.57
Income from lease of road..	\$131,725.28	367,389.37	-\$235,664.09
Miscellaneous rent income..	1,985,592.09	3,423,369.62	-\$1,437,777.53
Miscellaneous non-operating physical property	661,866.95	511,893.39	149,973.56
Separately operated properties—profit	1,520,309.00	32,194.95	1,488,114.05
Dividend income	10,309,802.89	6,316,257.46	3,993,545.43
Income from funded securities and accounts	3,418,230.56	3,171,612.70	246,617.86
Income from unfunded securities and accounts.....	1,682,200.64	2,783,072.72	-\$1,100,872.08
Income from sinking and other reserve funds.....	90,740.20	71,474.65	19,265.55
Miscellaneous income	749,193.35*	836,928.37*	87,735.02

TOTAL NON-OPERATING INCOME	\$19,051,274.26	\$20,121,944.06	-\$1,070,669.80
GROSS INCOME.....	\$69,951,088.73	\$75,097,499.15	-\$5,146,410.42

DEDUCTIONS FROM GROSS INCOME			
Rent for leased roads.....	\$6,690,584.92	\$6,703,480.51	-\$12,895.59
Miscellaneous rents.....	907,983.10	1,157,912.85	-\$249,929.75
Miscellaneous tax accruals..	269,685.70	278,196.10	-\$8,510.40
Separately operated properties—loss	3,613,257.88	1,323,143.08	2,290,114.80
Interest on funded debt....	34,855,173.31	33,598,469.01	1,256,704.30
Interest on unfunded debt..	1,062,567.93	7,196,207.16	-\$133,639.23
Amortization of discount on funded debt	572,510.98	553,788.43	18,722.55
Maintenance of investment organization	4,507.57	2,582.26	1,925.31
Miscellaneous income charges	1,339,631.28	1,988,033.97	-\$648,402.69

TOTAL DEDUCTIONS FROM GROSS INCOME.....	\$49,315,902.67	\$52,801,813.37	-\$3,485,910.70
NET INCOME.....	\$20,635,186.06	\$22,295,685.78	-\$1,660,499.72

DISPOSITION OF NET INCOME			
Dividends declared (5 per cent each year).....	\$12,876,984.76	\$12,479,641.01	\$397,343.75
Sinking funds	114,329.96	68,457.20	45,872.76

TOTAL APPROPRIATION OF INCOME	\$12,991,314.72	\$12,548,098.21	\$443,216.51
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SURPLUS FOR THE YEAR CARRIED TO PROFIT AND LOSS...	\$7,643,871.34	\$9,747,587.57	-\$2,103,716.23
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*Debit balance.			
Profit and Loss account			
BALANCE TO CREDIT OF PROFIT AND LOSS, DECEMBER 31, 1921.....			\$99,149,306.53
ADDITIONS:			
Surplus for the year 1922.....	\$7,643,871.34		
Profit on road and equipment sold.....	66,894.47	7,710,765.81	
DEDUCTIONS:			
Surplus appropriated for investment in physical property	\$85,003.63		
Debt discount extinguished through surplus.....	816,675.77		
Depreciation prior to July 1, 1907, on equipment retired during year.....	1,127,596.82		
Loss on retired road and equipment.....	396,738.83		
Loss on sale of capital stock of the Lake Erie & Western Railroad Company.....	2,847,016.78		
Premium on collateral trust 10-year gold bonds, called for redemption, at 105 per cent of par, September 1, 1922.....	1,080,325.00		
Uncollectible bills and sundry adjustments (net)	220,751.02	6,574,107.85	

BALANCE TO CREDIT OF PROFIT AND LOSS, DECEMBER 31, 1922.....			\$100,285,964.49
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Comparison of revenues, expenses and freight and passenger statistics

The following comparisons of revenues, expenses and freight and passenger statistics exclude the Ohio Central Lines and the Boston and Albany Railroad, separate statements for which will be found appended to this report.

Revenues, tonnage and passengers

The total operating revenues were \$316,620,098.02, an increase of \$24,489,102.96.

Freight revenue was \$197,980,517.80, an increase of \$18,809,685.77 notwithstanding the adverse conditions affecting tonnage and the rate reduction of July 1st elsewhere referred to in this report. Total revenue tonnage increased 11,602,048 tons. There was a decrease of 3,325,620 tons of anthracite coal, caused by the coal strike, but notwithstanding the suspension of bituminous coal traffic from certain mines during this strike, there was an increase in bituminous coal of 864,497 tons.

The revenue from passengers was \$79,837,137.79, a decrease of \$594,988.32. There were 9,649 more interline and 146,791 more commutation passengers carried than in 1921, but there was a decrease of 930,255 in local passengers. The amount of passenger traffic was somewhat affected by the coal and shopmen's strikes. Motor-bus competition was largely responsible for the falling off in the number of local passengers carried.

Express revenue was \$10,613,630.11, an increase of \$4,302,494.20. The express revenues of the company are based on a proportion of the net income of the American Railway Express Company. Of the increase over 1921, adjustment of over-accruals of certain reserves by the express company accounts for \$1,000,000 and operating economies instituted by it for the greater part of the remainder.

Rents of buildings and other property amounted to \$1,752,478.34, an apparent increase of \$1,272,894.02. This increase is almost entirely due to large adjustments which were made in this account in 1921 relating to prior periods.

Miscellaneous revenue, \$1,456,848.18, increased \$453,747.44. The heavier volume of traffic handled over the ore and coal docks at Ashtabula Harbor accounts for a large part of this increase.

Operating expenses

The following table shows the operating expenses by groups for 1922 com-

pared with those for 1921, the latter having been adjusted for the purposes of this comparison for the reasons set forth in the report for that year:

Group	Amount	Increase
Maintenance of way and structures.....	\$34,876,366.06	\$745,339.69*
Maintenance of equipment.....	82,992,957.54	18,537,086.60
Traffic	3,636,190.71	131,686.48
Transportation.....	116,938,168.20	4,376,629.03
Miscellaneous operations.....	3,610,928.65	283,495.25*
General	8,382,255.50	443,669.85*
Transportation for investment—credit.....	36,397.03	256,217.63
Total operating expenses.....	<u>\$250,400,469.63</u>	<u>\$21,829,114.95</u>

*Decrease.

The decrease in charges for maintenance of way and structures was in part due to reduced expenditures resulting from the lower cost of track material in 1922. There were increases in other items, important ones being crossings and signs \$148,398.32, station and office buildings \$372,498.57, shops and engine houses \$332,767.15 and telegraph and telephone lines \$96,834.41. These increases were mainly due to a greater amount of repair and renewal work.

The increase of \$18,537,086.60 for maintenance of equipment is due to extraordinary freight car repairs by which bad order cars were reduced approximately 50 per cent during the year; to extensive work on passenger equipment, necessitated by reason of repairs having been deferred in previous years for various causes; to increased locomotive repairs due to work deferred in 1921 on account of depression, when shops were closed for a protracted period; and to increased costs incident to the shopmen's strike.

Larger expenditure for printing freight and passenger tariffs is the principal reason for the increase in traffic expenses.

The increase in transportation expenses is, in the main, the result of the larger volume of traffic handled, although higher fuel costs contributed in some degree. There is one noteworthy item of decrease in this group—\$3,102,871.21 in loss and damage to freight, a reduction of 40 per cent.

The decrease in charges for miscellaneous operations is due largely to a change in methods of accounting in connection with stockyards.

Reduction in wages of clerical forces accounts almost entirely for the decrease in general expenses.

Railway tax accruals, equipment and joint facility rents

Tables setting forth the details of these accounts will be found in another part of this report.

Miscellaneous operations

The increases in revenues and expenses for this group are mainly due to the inclusion therein in 1922 of the operations of the stockyards at East Buffalo. In 1921 these operations were included in other accounts.

Non-operating income

The decrease of \$1,437,777.53 in miscellaneous rent income is largely the result of adjustments which were made in the accounts in 1921 corresponding to those in the account "Rents of buildings and other property" as hereinbefore set forth.

The increase of \$1,488,114.05 in "Separately operated properties—profit" is accounted for almost entirely by a profit from operation of the Boston and Albany Railroad of \$1,477,809.

Dividend income increased \$3,993,545.43. This increase is due in large part to the company's increased holdings of stock of The Cleveland Cincinnati Chicago and St. Louis Railway Company and to increased dividend paid by The Michigan Central Railroad Company.

The decrease in income from unfunded securities and accounts, \$1,100,872.08, is the result of the discontinuance of accrual of interest on deferred payments of compensation due from the United States Railroad Administration.

Deductions from gross income

There was an increase of \$2,290,114.80 in "Separately operated properties—loss." This account for 1922 includes a loss of \$3,586,808.11 from the operation of the Ohio Central Lines. The 1921 account included a loss from operation of the Boston and Albany Railroad of \$1,351,943.08.

Interest on funded debt increased \$1,256,704.30, funded debt having increased \$23,363,317.67 during the year.

The decrease of \$6,133,639.23 in interest on unfunded debt is attributable to the reduction in the amount of loans and bills payable and to discontinuance of accrual of interest on amounts due the United States Railroad Administration.

Net corporate income

After the payments of dividends aggregating 5 per cent, amounting to \$12,876,984.76, and appropriating for sinking fund purposes the sum of \$114,329.96, there remained a surplus of \$7,643,871.34, which was carried to the credit of profit and loss.

Reductions in freight rates

Under decision of the Interstate Commerce Commission, dated May 16, 1922, a ten per cent reduction in freight rates became effective on July 1st. It is estimated that the effect of this order, on the basis of the freight traffic handled in the last half of 1922, was to reduce revenue by approximately \$5,500,000. This reduction was not fully offset by wage reductions ordered by the United States Railroad Labor Board.

Taxes

Taxes have been steadily increasing. They amounted to approximately \$17,361,000 in 1922 as compared with \$8,324,000 in 1915, an increase of 109 per cent over 1915. Taxes per mile of road operated were approximately \$3,305 in 1922 as compared with \$1,609 in 1915, an increase of more than 100 per cent.

Account with Railroad Administration

The company's account with the Railroad Administration for the period of federal control is still undergoing check by the representatives of the Director General. It is hoped that this matter will be disposed of in 1923.

Claim against the United States upon the guaranty

The company's claim against the United States, based upon its guaranty for the period March-August, 1920, has been submitted and should reach settlement in 1923.

Wages

In the annual report for 1921, attention was called to negotiations with employees looking to further reductions in pay and to further changes in working conditions. These negotiations failed and the matters in dispute were referred to the Railroad Labor Board. Decisions of the Board were made, effective in most cases on July 1, 1922, reducing the rates of pay of several classes of employees. It is estimated that the effect of these decisions would have been to reduce the total wages payable by the company

in 1922 by approximately \$3,500,000, but the shop strike, referred to elsewhere in this report, prevented the realization of any of the benefits which would otherwise have resulted from the Board's findings.

Coal strike

After failure of negotiations between coal operators and the United Mine Workers of America, a general strike of United Mine Workers took place on April 1, 1922. The result was a suspension of work in the entire anthracite coal field and in all the unionized bituminous coal mines.

The federal government used its good offices to compose the differences between the operators and miners, but without result. Finally, in the latter part of August, the operators and United Mine Workers in joint conference agreed to resume operation of the bituminous mines upon the basis of the wages that had been effective prior to April 1st, with the result that by September 1st practically all the bituminous mines were active again. Shortly afterwards the anthracite operators and United Mine Workers reached an agreement.

Strike of shop craft employees

This company, in common with other railroad companies in the United States, was affected by the strike of the shop craft employees which became effective on July 1st and continued until a settlement was reached on September 19th.

Industrial development

During the year there were located upon the company's lines one hundred and eighty-one new industries, which will produce additional traffic estimated at 53,800 carloads per year. Twenty-one industries already located on the company's lines increased their facilities, the estimated result of which will be an increase of about 9,200 carloads annually.

Hudson River Connecting Railroad

Substantial progress is being made by the Hudson River Connecting Railroad Corporation upon the construction of its bridge across the Hudson River to connect the West Shore Railroad at Feura Bush with this company's road just north of Stuyvesant, with a branch to connect with the Boston and Albany Railroad. This project also includes a large classification yard at Feura Bush. It is expected that the bridge connection will be completed within the next two years. To the end of 1922, \$3,375,000 had been advanced by this company for the work.

Sale of capital stock of The Lake Erie and Western Railroad Company

During the year the company sold to the Western Company its holdings of capital stock in The Lake Erie and Western Railroad Company, amounting to 55,300 shares of preferred stock and 59,400 shares of common stock, for \$3,000,000.

Lease of Ohio Central Lines

The lease of the Toledo and Ohio Central Railway and subsidiary lines, referred to in last year's report, having been consented to by the holders of more than two-thirds of the capital stock of the company at a special meeting held on February 3, 1922, and having been approved by the Interstate Commerce Commission, became effective as of January 1, 1922. Separate tables showing the results of operation of this group of lines will be found in another part of this report under "The Ohio Central Lines." In this company's income account for 1922 the deficit from operation of the Ohio Central Lines is included under deductions from income in "Separately operated properties—loss."

Property investment accounts

Increases in the property investment accounts for the year, as shown in detail elsewhere in this report, were as follows:

Road	\$3,846,900.63
Equipment	6,953,265.01
Miscellaneous physical property	418,442.17
Improvements on leased property	1,116,649.51
Total	<u>\$12,335,257.32</u>

Acquisition of capital stock of The Cleveland Cincinnati Chicago and St. Louis Railway Company

The Interstate Commerce Commission having acted favorably on the company's applications for authority to acquire additional capital stock of The Cleveland Cincinnati Chicago and St. Louis Railway Company and to issue its own stock in exchange therefor, the company acquired during the year, under its offer of December 14, 1921, 82,352 shares of the preferred stock of that company in exchange for which it issued a like number of shares of its own stock (par value \$8,235,200), and 126,867 shares of the common stock in exchange for which it issued 101,493.6 shares of its own stock (par value \$10,149,360). At the end of the year the company held 82.36 per cent of the preferred, 91.21 per cent of the common and 89.66 per cent of the outstanding capital stock of The Cleveland Cincinnati Chicago and St. Louis Railway Company.

Acquisition of capital stock of The Michigan Central Railroad Company

The company acquired during the year 6,182 shares of capital stock of The Michigan Central Railroad Company at a cost of \$350 per share, making its holdings of that stock on December 31, 1922, 174,375 shares of a par value of \$17,437,500, or 93.06 per cent of the total outstanding.

Acquisition of the capital stock of The Chicago River and Indiana Railroad Company and lease to it of the Chicago Junction Railway

With the approval of the Interstate Commerce Commission, this company acquired, on May 19, 1922, at a cost of \$750,000, the entire capital stock (5,000 shares) of The Chicago River and Indiana Railroad Company, and by lease effective the same day, that company became the lessee of the Chicago Junction Railway for a term of ninety-nine years with the option of renewal in perpetuity, at a rental of \$1,500,000 for the first year and \$2,000,000 per annum thereafter, the lessee to pay the taxes upon the property. This company joined in the lease for the purpose of guaranteeing performance by the lessee of its covenants therein made.

Acquisition of stock and guaranty of bonds of The Cleveland Union Terminal Company

The company purchased during the year 68 shares of the capital stock of The Cleveland Union Terminal Company (par value of \$100). The remainder of the stock of the Terminal Company is held, 19 shares by The Cleveland Cincinnati Chicago and St. Louis Railway Company, 4 shares by The New York, Chicago and St. Louis Railroad Company, and 9 shares by directors of The Cleveland Union Terminal Company, each of the railroad companies having an option upon three of such directors' shares. The proprietor companies have entered into an agreement with The Cleveland Union Terminal Company to join in a joint and several guaranty of its first mortgage bonds, principal and interest, of which not exceeding \$60,000,000 are

issuable. The first series of such bonds, series A, consisting of \$12,000,000 of fifty-year five and one-half per cent bonds, were issued, guaranteed and sold to the public during 1922.

Capital stock

The outstanding capital stock of this company was increased during the year by the issue of \$18,384,560 par value which was exchanged for preferred and common stock of The Cleveland Cincinnati Chicago and St. Louis Railway Company, as more fully set forth elsewhere in this report. The capital stock in the hands of the public on December 31, 1922, amounted to \$267,981,915.

The total number of stockholders at the end of the year was 34,319, of whom 33,843 were located in the United States and 476 abroad, the average holdings being 78 shares and 70 shares, respectively.

The following table shows the growth in the number of stockholders from 1915 to 1922, both inclusive:

Date	Total		In United States		Abroad	
	Number	Average holding	Number	Average holding	Number	Average holding
Dec. 31, 1915	25,042	100	22,270	104	2,772	64
Dec. 31, 1916	22,532	111	21,836	112	696	56
Dec. 31, 1917	27,102	92	26,771	92½	331	69
Dec. 31, 1918	28,693	87	28,395	87	298	69
Dec. 31, 1919	30,445	82	30,180	82	265	67
Dec. 31, 1920	32,396	77	32,173	77	223	64
Dec. 31, 1921	34,328	73	33,824	73	504	70
Dec. 31, 1922	34,319	78	33,843	78	476	70

Changes in funded debt

ISSUE OF REFUNDING AND IMPROVEMENT MORTGAGE FIVE PER CENT BONDS, SERIES C

The company issued during the year \$85,000,000 of its refunding and improvement mortgage bonds of series C, consisting of issues of \$60,000,000 and \$25,000,000, respectively.

Of the proceeds of the \$60,000,000 issue, \$26,500,000 was used to take up the company's 6 per cent demand notes dated October 25, 1920, and August 4, 1921, for \$7,000,000 and \$19,500,000, respectively, which had been given to the Director General of Railroads in payment for that amount of additions and betterments made to the properties of the company during federal control; \$11,945,000 thereof was used to pay bonds of the Rome Watertown and Ogdensburg Railroad Company and of the Utica and Black River Railroad Company, predecessors of this company, which became due on July 1, 1922; and the balance thereof was held to pay the Director General of Railroads, and to reimburse the company's treasury for expenditures made, for additions and betterments.

The proceeds of the \$25,000,000 issue were applied toward the retirement of the company's ten-year 7 per cent collateral trust bonds dated September 1, 1920, which were called for redemption as hereinbefore stated.

ISSUE OF EQUIPMENT TRUST CERTIFICATES

Under the New York Central Lines Equipment Trust of 1922 there were issued \$27,645,000 of certificates, of which this company's share is \$8,580,000.

RETIREMENT OF REFUNDING AND IMPROVEMENT MORTGAGE SIX PER CENT BONDS, SERIES B

During the year, \$6,494,000 of the company's refunding and improvement mortgage bonds, series B, which had been pledged as collateral security for the loan made to the company by the Government under Section 210 of the Transportation Act, \$7,000,000 thereof pledged as collateral security for the company's demand note for that amount to the Director General of Railroads, and \$25,000,000 thereof pledged to secure the company's ten-year 7 per cent collateral trust bonds, were redeemed from pledge by the payment of the obligations for which pledged. Of the bonds so released, \$34,000,000 were cancelled. The remaining \$4,494,000, being a part of the bonds formerly pledged for the Government loan, are held in the treasury of the company.

RETIREMENT OF TEN-YEAR SEVEN PER CENT COLLATERAL TRUST BONDS

The company's ten-year collateral trust bonds, dated September 1, 1920, for a principal amount of \$25,000,000, were called for redemption on September 1, 1922, at the redemption price of 105 per cent of par, and were refunded by the issue of a like amount of refunding and improvement mortgage 5 per cent bonds of series C, as hereinbefore stated.

PAYMENT OF NOTES HELD BY SECRETARY OF THE TREASURY

The company paid during the year all but \$609,000 of the balance remaining unpaid of the loan made to it in 1920 by the United States under Section 210 of the Transportation Act, evidenced by 6 per cent notes dated December 23, 1920. These repayments consisted of \$13,860,000 in full payment of the unpaid balance of the serial notes maturing in annual installments originally aggregating \$14,850,000, and \$11,316,000 paid upon the ten-year note, originally for \$11,925,000. The notes of subsidiary companies given to this company in connection with the loan from the United States, described in the report for 1920, were paid by them, except an unpaid balance of \$3,822,000 upon The Cleveland Cincinnati Chicago and St. Louis Railway Company's ten-year note and of \$2,178,000 upon the serial notes of that company and except the Lake Erie and Western Railroad Company's ten-year note for \$609,000.

The changes in the funded debt of the company, in detail, were as follows:

The amount on December 31, 1921, has been increased as follows:	\$739,592,968.85
N Y C Lines Equipment Trust 5 per cent certificates of June 1, 1922.....	\$8,580,000.00
N Y C R R Co Refunding and improve- ment mortgage 5 per cent bonds.....	85,000,000.00

and has been reduced as follows:

Payment of notes:	
Ten-year promissory note—Secretary of the Treasury of the United States.....	\$11,316,000.00
Serial notes—Secretary of the Treasury of the United States, due December 23, 1922 to 1935.....	13,860,000.00
Ten-year 7 per cent collateral trust gold bonds called for redemption September 1, 1922.	25,000,000.00
Rome Watertown and Ogdensburg Railroad Co First consolidated mortgage bonds, matured July 1, 1922.....	9,993,000.00
Utica and Black River Railroad Co First mortgage bonds, matured July 1, 1922....	1,950,000.00

Payments falling due during the year and on January 1, 1923, on the company's liability for principal installments under equipment trust agreements as follows:

N Y C Lines Trust of 1907, final installment due November, 1922.....	1,492,884.75
N Y C Lines Trust of 1910, installment due January, 1923	1,406,413.74
M D T Co Trust of 1911, installment due July, 1922	75,000.00
N Y C Lines Trust of 1912, installment due January, 1923	688,398.90
Boston and Albany Trust of 1912, installment due October, 1922.....	500,000.00
N Y C Lines Trust of 1913, installment due January, 1923	742,117.61
N Y C R R Co Trust of 1917, installment due January, 1923	1,117,000.00
Trust No. 43 of January 15, 1920, installment due January 15, 1922.....	922,700.00
N Y C R R Co Trust of April 15, 1920, installment due April 15, 1922.....	1,153,167.33

leaving the funded debt on December 31, 1922
a net increase of \$23,363,317.67.

*Does not include \$2,000 previously acquired by the company.

Loans and bills payable

In addition to the funded debt there were outstanding on December 31, 1922, the following loans and bills payable:	
Secretary of the Treasury of the United States—6 per cent—	
on demand	\$6,500,000.00
J. P. Morgan & Company—4½ per cent—on demand.....	6,000,000.00
Miscellaneous	13,000.00
Total	\$12,513,000.00

The note indebtedness to the Director General of Railroads of \$26,500,000 shown in the annual report for 1921, was paid during 1922.

Termination of New York Central Lines equipment trust of 1907

The New York Central Lines equipment trust of 1907 having expired on November 1, 1922, the title to the equipment was transferred by the Trustee to the several railroad companies, parties to the trust, in proportion to the amount of the cost thereof paid by each company, respectively. This company's share of the equipment so transferred from trust to railroad owned consisted of 577 locomotives, 145 passenger-train cars, 11,305 freight-train cars and 338 work-train cars.

New York Central Lines equipment trust of 1922

This trust was created by agreement dated June 1, 1922, to which The New York Central Railroad Company, The Michigan Central Railroad Company, The Cleveland Cincinnati Chicago and St. Louis Railway Company, The Cincinnati Northern Railroad Company, The Pittsburgh and Lake Erie Railroad Company, and the Pittsburgh McKeesport and Youngstown Railroad Company are parties. Under the trust \$27,645,000 of 5 per cent equipment trust certificates maturing in equal annual installments of \$1,843,000 over a period of fifteen years were issued, representing approximately 75 per cent of the cost of the equipment which was leased by the Trustee to the railroad companies. The equipment allotted to this company under the trust consists of five thousand freight cars and fifty switching locomotives costing approximately \$11,443,160. The certificates are prorated among the railroad companies in proportion to the cost of the equipment allotted to each, this company's share being \$8,580,000.

New York Central Lines four and one-half per cent equipment trust of 1922

This trust was created by agreement dated September 1, 1922, to which The New York Central Railroad Company, The Michigan Central Railroad Company, and The Cleveland Cincinnati Chicago and St. Louis Railway Company are parties. Under the trust \$12,660,000 of 4½ per cent equipment trust certificates maturing in equal annual installments of \$844,000 over a period of fifteen years are issuable, representing approximately 75 per cent of the cost of the equipment leased by the Trustee to the railroad companies. The equipment allotted to this company under the trust consists of one hundred and sixty locomotives estimated to cost \$11,384,000. No certificates were issued during the year. When issued they are to be prorated among the railroad companies in proportion to the cost of the equipment allotted to each, this company's share being \$8,535,000.

Improvements

Important improvements completed or under way during the year, or contemplated for the near future, are as follows:

Pensions

In the operation of the Pension Department, 425 employees were retired and placed upon the pension rolls. Of these retirements, 245 were authorized because of the attainment of seventy years of age, and 180 because of permanent physical disability. Two hundred and twenty-two pensioners died during 1922. At the close of the year, 2,117 retired employees were carried upon the pension rolls. The total amount paid in pensions during the year was \$804,444.14. The pension system has been extended to apply to the employees of the Ohio Central Lines.

Changes in organization

The Board records, with deep regret, the death of the following:

Abraham T. Hardin, Director and Vice President, February 21;
John Carstensen, Vice President, April 14;
William Rockefeller, Director, and member of Finance Committee, June 24.

The Board records the election or appointment of the following:
John L. Purdett, Vice President, May 10;
Edwin N. Bennett, Assistant Treasurer, October 1;
John G. Walber, Vice President, Personnel, November 1;

Walter P. Bliss, Director, November 29, to fill the vacancy caused by the death of Mr. Hardin.

Alfred H. Smith, member of Finance Committee, December 13, to fill the vacancy caused by the death of Mr. Rockefeller.

Appreciative acknowledgment is made to officers and employees of their loyal and efficient co-operation and service.

For the Board of Directors,

ALFRED H. SMITH, President.

Railway Officers

Executive

T. O. Jennings, traffic manager of the Chicago & Eastern Illinois, with headquarters at Chicago, has been elected vice-president in charge of traffic, with the same headquarters.



T. O. Jennings

Mr. Jennings was born on October 9, 1873, at Waukeen, Iowa. He entered railway service in 1892 as a clerk in the local freight office of the Des Moines Union Railway at Des Moines, Iowa. In 1898 he was appointed contracting agent for the Chicago, Rock Island & Pacific at Des Moines and the same year was transferred to Kansas City, Mo. He was promoted to traveling freight agent, with the same headquarters, in 1901, and a year later was promoted to division freight agent, with headquarters at Chicago. He was appointed joint general agent for the Chicago, Rock Island & Pacific, the St. Louis-San Francisco and the Chicago & Eastern Illinois, with headquarters at Milwaukee, Wis., in 1903, and served in this capacity until 1907, when he was promoted to freight claim agent for the Chicago & Eastern Illinois, with headquarters at Chicago. In 1908, Mr. Jennings was appointed general agent at Chicago and two years later was promoted to assistant general agent, with the same headquarters. He was promoted to general freight agent in 1912, and held this position until 1915, when he was promoted to freight traffic manager, with the same headquarters. He was serving in this capacity at the time of his recent election as vice-president in charge of traffic.

Financial, Legal and Accounting

G. A. Burget, who has been elected secretary of the Chicago & Eastern Illinois, was born on January 9, 1883, at Terre Haute, Ind. He entered railway service in 1904 as a stenographer on the Pennsylvania, serving in both the operating and traffic departments. He was appointed secretary to the general freight and passenger agent of the Chicago, Terre Haute & Southeastern in 1905, and held this position until November, 1906, when he entered the service of the Chicago & Eastern Illinois as a stenographer in the office of the general manager. He was later promoted to secretary to the general manager and then to secretary to the president. He was promoted to assistant chief clerk to the receiver and federal manager, and at the time of reorganization of the road was appointed chief clerk to the president. Mr. Burget held this position at the time of his recent election as secretary and will continue his duties as chief clerk in addition to the secretarial work.

Operating

D. B. Mulligan, whose appointment as general manager of hotels of the Canadian National with headquarters at Winnipeg, Manitoba, was announced in the *Railway Age* of March 10, 1923, page 592, was born on November 10, 1870, at Pembroke, Ont. He was educated at Pembroke High School and entered railway service in 1914 with the Grand Trunk Pacific Development Company and since that time has been in the service of that company and its successors including the Canadian National Railways.

P. Groome, assistant superintendent of the Colorado division of the Union Pacific, with headquarters at Denver, Colo., has been promoted to acting superintendent of the Kansas division, with headquarters at Kansas City, Mo., succeeding G. O. Brophy, whose promotion to assistant to the general solicitor, with headquarters at Omaha, Neb., was reported in the *Railway Age* of June 16. **P. C. Kinney**, trainmaster of the Colorado division, with headquarters at Denver, Colo., has been promoted to acting assistant superintendent, with the same headquarters, succeeding Mr. Groome. **H. A. Riebow**, chief clerk in the office of the division superintendent at Kansas City, Mo., has been promoted to trainmaster of the Colorado division, with headquarters at Denver, succeeding Mr. Kinney.

Roy B. White, whose appointment as general manager of the New York Terminal lines of the Baltimore & Ohio was announced in the *Railway Age* of June 2, page 1350, was born

at Metcalf, Ill., on August 8, 1883, and received a high school education. He entered railway service in 1900 as a telegraph operator on the Indiana, Decatur & Western (now Cincinnati, Indianapolis & Western). In 1902 he was promoted to train dispatcher at Indianapolis. In 1908 he became chief dispatcher for the Cincinnati, Hamilton & Dayton at the same point and the following year was appointed chief clerk to the general superintendent at Cincinnati. In 1910 he was promoted to superintendent at Indianapolis.

Five years later he was appointed to a similar position with the Baltimore & Ohio at Flora, Ill., and he later served in the same capacity at Seymour, Ind., Philadelphia and Baltimore. On April 15, 1921, he was promoted to general superintendent at Baltimore, which position he was holding at the time of his recent promotion.



R. B. White

Traffic

D. McLure has been appointed assistant general passenger agent of the Chicago, Rock Island & Pacific with headquarters at Chicago.

C. H. Owen has been appointed assistant general freight agent of the Southern Pacific, Louisiana Lines, with headquarters at New Orleans, La.

D. L. Gordon has been appointed division freight agent for the Pere Marquette, with headquarters at Saginaw, Mich., succeeding W. Henderson, deceased.

O. L. Dane has been appointed general freight and passenger agent of the Louisiana Railway & Navigation Company of Texas, with headquarters at Greenville, Tex.

Ira G. Faulkerson has been appointed traveling freight agent of the Buffalo, Rochester & Pittsburgh with headquarters at Buffalo, N. Y., succeeding R. W. Anderson, assigned to other duties.

C. L. Farrell, superintendent of station service of the Erie, with headquarters at Chicago, has been promoted to division freight agent, with headquarters at Dayton, Ohio, succeeding E. J. Brattain, deceased.

A. W. Noyes, assistant general passenger agent of the Chicago Great Western, with headquarters at Chicago, has been promoted to general passenger agent, with the same headquarters, succeeding **W. R. MacFarland**, who has resigned to become assistant to the president of Poole Brothers, railroad printers.

H. G. Buchanan, district freight agent for the Canadian Pacific, with headquarters at London, Ont., has been transferred to Toronto, Ont., succeeding G. C. Cochran, deceased. **W. J. Anderson** has been appointed district freight agent, with headquarters at London, Ont., succeeding Mr. Buchanan.

F. C. Francis has been appointed manager of mail, baggage and express traffic of the Chicago, Rock Island & Pacific with headquarters at Chicago, succeeding C. A. Searle, promoted. **J. P. Kilty** has been appointed assistant manager of mail, baggage and express traffic with the same headquarters.

R. K. Pretty, assistant general freight agent of the Great Northern, with headquarters at Chicago, will resign on July 1 to engage in other business. **T. J. Shea**, general agent, freight department of the Chicago & Alton, with headquarters at Chicago, has been appointed assistant general freight agent of the Great Northern, with the same headquarters, succeeding Mr. Pretty.

W. H. Donny, general agent, passenger department, of the Missouri Pacific, with headquarters at New York, has been promoted to assistant general passenger agent, with headquarters at Kansas City, Mo. **D. I. Lister**, traveling passenger agent, with headquarters at New York, has been promoted to general agent, passenger department, with the same headquarters, succeeding Mr. Donny.

C. A. Searle, manager of mail, baggage and express traffic of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to general passenger agent, with headquarters at Kansas City, Mo., succeeding

J. A. Stewart, who has been appointed industrial commissioner, with headquarters at Kansas City. Mr. Searle was born on July 22, 1866, at Fairfax, Vt., and entered railway service in 1886 as a clerk in the office of the superintendent and general freight and passenger agent of the Missisquoi Valley. In 1891 he was appointed chief clerk to the freight traffic manager of the Central Vermont at St. Albans, Vt., and in 1893 was promoted to chief claim clerk. He was appointed chief clerk in the traffic department of the Baltimore Steam Packet Company at Baltimore, Md., in October, 1895, and held this position until December, 1897, when he entered the signal service bureau of the War Department at Washington, D. C. Mr. Searle entered the service of the Chicago, Rock Island & Pacific on December 1, 1898, as general excursion agent. In October, 1902, he was appointed secretary to the passenger traffic manager and in January, 1910, was appointed secretary to the third vice-president. He was promoted to manager of mail traffic on January 1, 1912, and on March 1, 1914, was appointed general baggage agent in addition to his duties as manager of mail traffic. His jurisdiction was extended over express traffic on December 1, 1914. At the termination of federal control on March 1, 1920, he was appointed manager of mail, baggage and express traffic, with headquarters at Chicago, and was serving in this capacity at the time of his promotion to general passenger agent, with headquarters at Kansas City.

J. A. Stewart, who has been promoted to industrial commissioner of the Chicago, Rock Island & Pacific, with headquarters at Chicago, was born in 1867, at London, Ont. He entered railway service as an office boy on the Great Western of Canada. In 1885 he entered the service of the Union Pacific as a freight clerk at Abilene, Kan., and two years later was promoted to chief clerk at Salina, Kan.

He was appointed ticket clerk for the Chicago, Rock Island & Pacific at Kansas City, Mo., in 1888, and was promoted to traveling passenger agent, with the same headquarters, in 1892. A year later Mr. Stewart was promoted to city passenger agent at Des Moines, Ia., in which position he served until 1901, when he was promoted to division passenger agent, with headquarters at Kansas City, Mo. He was promoted to general agent for the passenger department, with the same headquarters, in 1903, and on January 1, 1908, was promoted to assistant general passenger agent, with the same headquarters. Mr. Stewart was transferred to Chicago on January 1, 1910. He was promoted to general passenger agent, with headquarters at Topeka, Kan., on February 1, 1911, and on August 1, 1915, was transferred to Kansas City, Mo. He was serving in this capacity at the time of his recent promotion to industrial commissioner, with headquarters at Chicago.

Mechanical

C. C. Peters, road foreman on the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., and **H. B. Wells** have been appointed fuel supervisors, with headquarters at Chicago.

J. T. St. Clair has been appointed acting engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, succeeding **E. Posson**, who has been granted leave of absence for six months.

The following appointments have been made in the fuel department of the Boston & Maine: **W. E. Small**, chief fuel inspector; **A. J. Whelan**, inspector, fuel service; **W. F. Maher**, inspector, fuel service; **J. J. Tobin**, inspector fuel service; **W. E. Chase**, chief fuel supervisor; **J. E. Barber**, fuel supervisor, Portland division; **J. R. Annis**, fuel supervisor, Portland division; **N. L. Wiggan, Jr.**, fuel supervisor, Interdivision runs; **C. C. McCutcheon**, fuel supervisor, covering all Southern division, except north of Concord; **J. L. Emery**, fuel supervisor, Fitchburg division; **F. J. McShalley**, fuel supervisor, Berkshire division; **W. E. Colby**, fuel supervisor, W. N. & P. division; **W. G. Gray**, fuel supervisor, White Mts. and Passumpsic division; **Thomas Bell**, fuel supervisor, Connecticut river division, and Southern division, north of Concord.

O. S. Jackson, whose appointment as superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., was reported in the *Railway Age* of June 9, entered railway service in 1889 in the mechanical department of the Erie at Huntington, Ind. From 1897 to 1905 he served in the mechanical department of the Cleveland, Cincinnati, Chicago & St. Louis, being appointed general foreman on the Chicago, Indianapolis & Louisville during the latter year. He was promoted to master mechanic in 1909, and in 1913 was appointed superintendent of motive power of the Chicago, Terre Haute & Southeastern, with headquarters at Terre Haute, Ind. A year later he was promoted to general superintendent in charge of the mechanical and transportation departments, with the same headquarters. Mr. Jackson was appointed assistant superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., in September, 1921, which position he held at the time of his recent promotion to superintendent of motive power and machinery.

Special

E. H. McReynolds has been appointed editor of the Missouri Pacific Magazine, with headquarters at St. Louis, Mo.

Obituary

W. D. Lincoln, car service agent for the Union Pacific, with headquarters at Omaha, Neb., died in that city on June 5.

O. W. Karn, vice-president of the Brotherhood of Locomotive Firemen and Enginemen, died at Oakland, Cal., on June 13. Mr. Karn was 52 years of age.

J. J. Eddy, division freight agent for the Missouri Pacific, with headquarters at East St. Louis, Ill., died at the Missouri Pacific hospital at St. Louis, Mo., on June 12.